AMATEUR WORK

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THE AMATEUR RUNABOUT.

FREDERICK A. DRAPER.

I. General Design.

The design of the runabout to be described in this series of articles is as simple in construction as a serviceable vehicle will permit, and the work will not be found difficult by anyone having reasonable skill in the use of a screw-cutting lathe. With the exception tion of the balance wheel on the engine, all the machine work can be done on a 9-inch lathe, this being a size in common use among amateur mechanics. It is quite probable that, of those making a car from this description, some will prefer to buy complete parts, such as the engine, in preference to making them, therefore the several chapters will be progressively arranged with this in view, the frame and running gear being first described, the engine being taken up last.

As will be noted from the illustrations, an air-cooled gasoline engine, *E*, is the motive power, one with a 3½ in. cylinder at 1200 to 1500 rev. per min., providing sufficient power for all except a very hilly country. If greater speed and power is thought desirable, a slightly larger engine can be used; it may also be water.

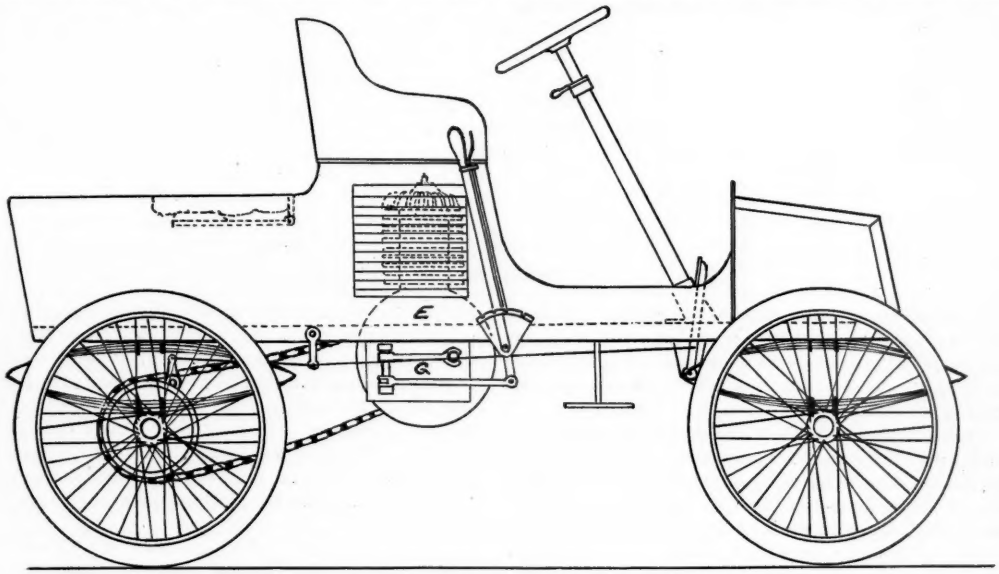


FIGURE 1. SIDE VIEW.

cooled if the maker prefers that type, as there is plenty of room in the hood for radiator tubes, gasoline tank and a tool box of ample capacity.

As one of the requirements of this car is as low a cost as possible, wire-spoked wheels with wood rims are used, although cost was not the sole reason for adopting this

kind of wheel. It can, in case of an accident, be easily repaired at about any bicycle repair shop, and at small cost ; whereas a wooden wheel, when out of order, requires a skilled wheelwright to repair it. The rims are cresent shape.

The tire question is of decided importance, and, after considering all the advantages of the various types, the single tube, 28 x 2½ in., was selected as being most suitable. A 2 in. tire can be used, but the saving in first cost would soon be offset by renewals, the smaller tire having comparatively thin walls, and not heavy enough for continuous work. In addition, the difference in first cost between the two sizes is not very great, and the larger size is enough more durable to warrant the extra expense.

price. The expansion clutch is of the metal-to-metal type, very similar to one described in a recent issue of this magazine.

The front axle is of the usual type with forged steering knuckles for ball bearing hubs. The pivots should also be forgings. The rear axle is of the "live" type, with differential and sprocket enclosed in a muff, to which is attached the axle casing. The hubs of the rear wheels are keyed in.

The frame for the body is of angle iron with cross ties of the same, which gives a rigid yet light construction. The springs shown, four leaf, 32 x 1¼ in., are the double eliptic, but ¾ eliptic springs with suitable hangers can be used if preferred, but are more expensive. It will be noted that the engine, the heaviest single

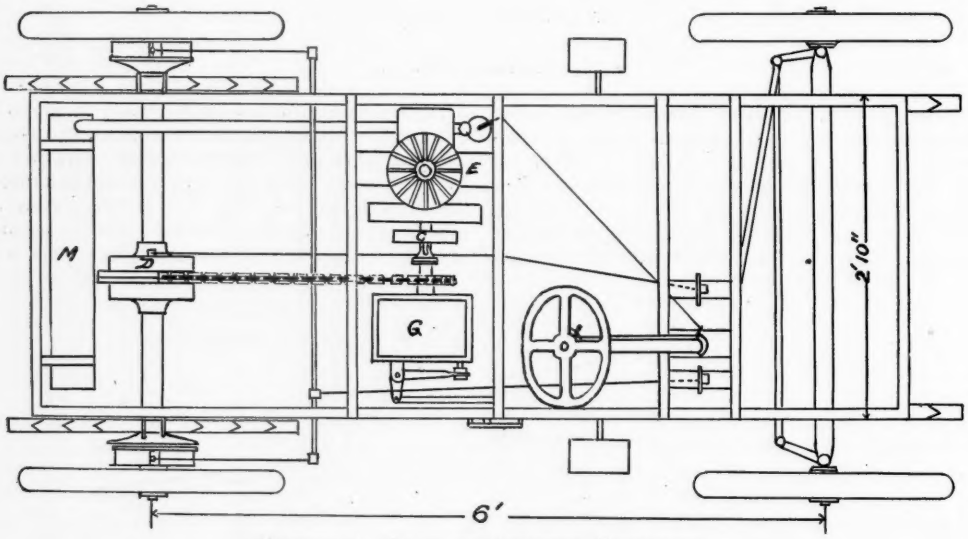


FIGURE 2. PLAN OF AMATEUR RUNABOUT.

In addition to the brake on the differential, drum brakes are shown on the rear wheels. The latter are necessary only in the event of the car being used in a rather hilly country, and plenty of power desired for holding on steep grades.

A wheel steering device is shown, but a lever may be substituted, and is quite sufficient for such a light car. Whichever form is used, the driver should at all times keep it in the control of the hand ; carelessness in this regard being responsible for many avoidable accidents.

The change-speed case *G*, expansion clutch *C*, and a few other parts, have been designed especially for this car. Two speeds forward, 6 and 24 miles, and a reverse, are quite sufficient for a car of this size, and by omitting one forward change (three changes being the usual number) a much lighter and more easily made gear-case is obtained. On the high speed no gears are in mesh, the drive being direct. Ample lubrication is also provided. Castings for the special parts are being prepared, and can be purchased at very reasonable

part of the car, is placed on the side opposite the driver, thus serving to balance the car when carrying only one, who is generally the heavier when two are riding. It will also be noted that provision is made for having the top of the rear part of the body hinged to fold back on itself, and fitted with a seat and light frame back support, thus allowing children to be carried, which can be done on level roads. When not so used, ample space is provided for luggage needed on a long trip.

The body can easily be constructed, or if the feature just mentioned is not needed, can be purchased "in the white" of a dealer, the size being right for stock bodies to be found in catalogs of several supply houses. An important point to be kept in mind is that all parts, though well protected from the elements, dust or mud, should be easily accessible.

The muffler *M* is of ample capacity to allow of a nearly noiseless exhaust, and also avoid back-pressure. The carburettor should be purchased, as very

few mechanics have the tools, skill and experience necessary to make one that will give anything like satisfactory results ; generally the reverse. The best that can be purchased will be found the most economical in the end, and the increased efficiency of motor make the purchase desirable.

As the various parts are presented in the several chapters, detail drawings and directions will be given, with partial assembly drawings when needed. The wheels will be described in the following chapter, and those proposing to build the car can profitably look up, in the interim, the nearest supply house carrying hubs, knuckles, spokes, rims, etc. The diameter of axles is ⅞ in.

NOTES ON WIRELESS TELEGRAPHY.

L. T. KNIGHT.

V. Peculiarities of Coherer Action.

A question frequently propounded by beginners in wireless experiment work is that of how far wireless signals may be transmitted by a given spark. It is to be presumed that the writer contemplates purchasing an induction coil of one or more inches spark length, and wishes to use it for communication with a station several miles distant, but foreseeing numerous expenditures for appartus, seeks advice as to the advisability of proceeding with such a limited source of energy. In attempting to answer the above question it is well to state that there seems to be a very general misunderstanding regarding the principles of wireless signaling, especially in regard to the receiving apparatus, and the functions performed by the latter.

In order to follow intelligently the advances of wireless telegraphy it is necessary to have a general idea of the modern scientist's view regarding the nature of electrical phenomena.

All space must be regarded as something styled the "luminiferous ether." Not only does this ether permeate all space, but it also permeates all solids. Further, its nature is such that the movement of solids is not restrained by such permeation, the closest analogy being that of a wire sieve, representing the solid, being moved about in the water, which represents the ether.

This ether is the sea, not only of all electrical phenomena, but also of all the phenomena of heat and light. Heat, light and electricity are but the result of vibrations or waves in the ether, the apparent differences being due to the differences in length and frequency, just as one musical note differs from another in the same particulars, only that sound waves are air waves, not ether waves.

It is claimed that in wireless telegraphy that currents are vibrations of the ether along the path of the wire. That is, the wire acts merely as a guide for the ether waves.

In wireless telegraphy ether vibrations are also set up at the transmitting end, but these waves have no conducting guide, and so radiate in all directions through space, and a small percentage of them arrive at the receiving end where they are caught on the aerial wire and caused to record themselves upon a coherer or similar device.

The first receiving device studied by the amateur is the coherer, the earliest successful collector of Hertzian waves. The coherer is an insulated container, usually a tube of glass. Sealed between two metal plugs in this tube may be found fillings of iron, antimony, silver or nickel, in quantitities and proportions calculated by the designer to give the most satisfactory results under certain conditions or distance. Each coher of a collection has some especial qualification, determined by tests after manufacture ; some are suited for long distance and some for short, all vary in sensitivity after repeated use.

When inserted in the relay circuit a coherer must be susceptible to waves entering on the aerial wire, and cohere or, rather, the filings inclosed in the tube must cohere or "stick" electrically more closely together, causing a sudden fall in resistance to a point where the battery in the relay circuit may pass through both coherer and relay, and thus operate a sounder and other recording devices.

Often the first of a chain of waves will somewhat lessen the coherer resistence, but not sufficiently to operate the relay. In this case more waves must perform their duty upon the coherer before the first dot or dash can be recorded. While waves come to the coherer at a rapid rate, this delay in cohering counts considerably, both in accuracy and in the time it takes to send a given message. Hence the necessity of having the coherer as sensitive as possible.

Connected in one branch of the receiving circuit is the decoherer, a device operated electrically like a vibrating door bell, which taps the coherer near the filings chamber with the purpose of restoring or decohering the filings to that state of inactivity where no current can pass through the relay until one or more waves have again reached the aerial wire. Oft times the tapper, instead of completely performing its function, simply partially decoheres thefilings, causing errors in recording. Frequently the tapping throws the filings into a state of higher resistance than formerly, and makes readjustment of the relay circuit necessary, for it must be remembered that in setting up the relay and battery circuit a variable resistance was included, by which the current was kept at a point where it

would not force through the coherer normally but would press through instantly when the resistance of the coherer was lowered by incoming waves. Such is the theory of the coherer, and to date no amount of tinkering with vacuum or filings, or distance between electrodes will greatly alter the situation. Atmospheric disturbances will store electrical charges upon aerial wires, and the coherer operates at random moments.

The writer recalls, while visiting quite recently a coherer receiving station, the illegible records made on the tapes by the impulses that followed along with and after the regular message. These marks were explained by the operator to be atmospheric disturbances which were caught because the coherer and relay circuit were adjusted to a most sensitive degree, owing to the extreme distance between stations.

To the coherer must be given the credit, however, of opening up the field of investigation more effectively, because of these very short comings. Many wireless experts dropped the coherer principle after a few trials and took up the study of electrolytic, thermostatic and magnetic detectors, many of which, like the coherer, at times have their failings.

The problem of recording, by means of a relay and recording device, waves which decrease in direct proportson to the distance between stations, is a task calcuated to cause many a clever man much loss of sleep. How to take an accurate, decipherable record of an impulse transmitted from a point a thousand miles away, possessing less than one thousandth of the energy it had when wafted from its sending aerial, is a problem, the final solution of which should mean a comfortable fortune for the inventor, and a wide development of wireless telegraphy.

A GASOLINE TOURING CAR.

R. G. GRISWOLD.

IV. Two Cylinder Air Cooled Engine.

In machining the piston a special arbor is made to mount it on, as the truest and best work can be done in this way only. Grip the piston in a chuck or strap it to a face plate and bore out the hole in the head. Turn up an arbor two inches longer than the piston, one end of which is slightly tapered so as to drive into the bored hole. The opposite end is then provided with four tapped holes, 90° apart, to receive ¼ or 5-16 in. screw pins.

The tapered end of the mandril is then driven into the hole and the pins screwed out against the inside of the shell, centering the open end. The piston may now be turned in the lathe, and a very true cylinder obtained. The ring grooves must be cut very smooth and true, and the sides may be finished best by using a keen hand tool and scraping off a very light cut as the piston revolves. Do not allow chattering to take place, as much of the tightness of the piston against leakage depends upon the fit of the rings in these grooves. Three "water grooves" are turned in the end of the piston, which serve to carry oil to all parts of the cylinder. The head is also squared before removing from the lathe.

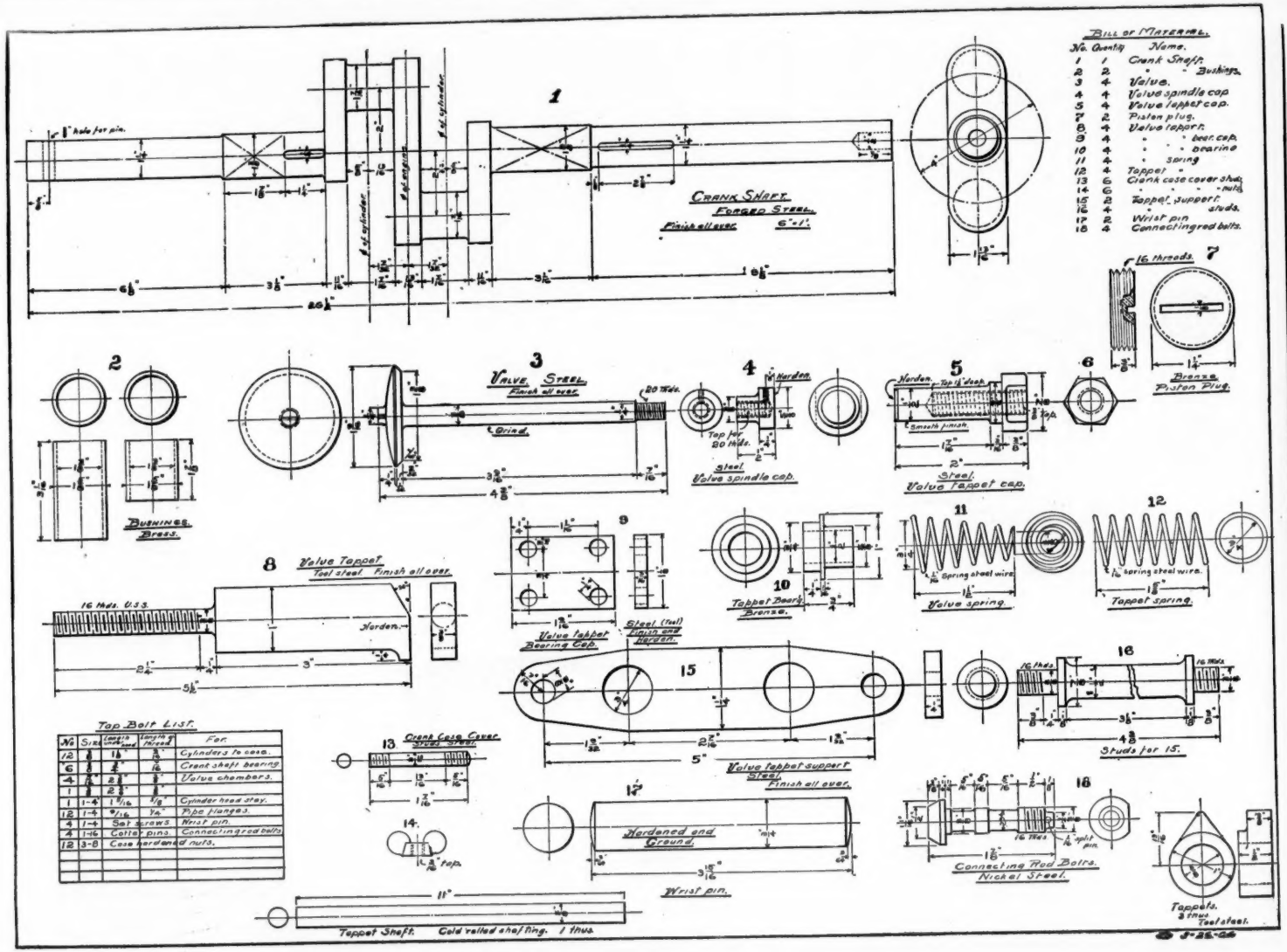
For boring the cross-head pin hole, make two very shallow V blocks, not over ¼ in. thick at the bottom of the V. Strap the piston against the face plate, using these V blocks to rest it on. Lay off the centers of the inside bosses on the outside and use this point for centering. Then drill completely through, either with a ⅜ in. drill or a smaller one, finishing the hole by boring with a tool. Drilling and tapping the holes for the set screws and screwing the plug in the hole (threaded in the chuck), finishes the piston.

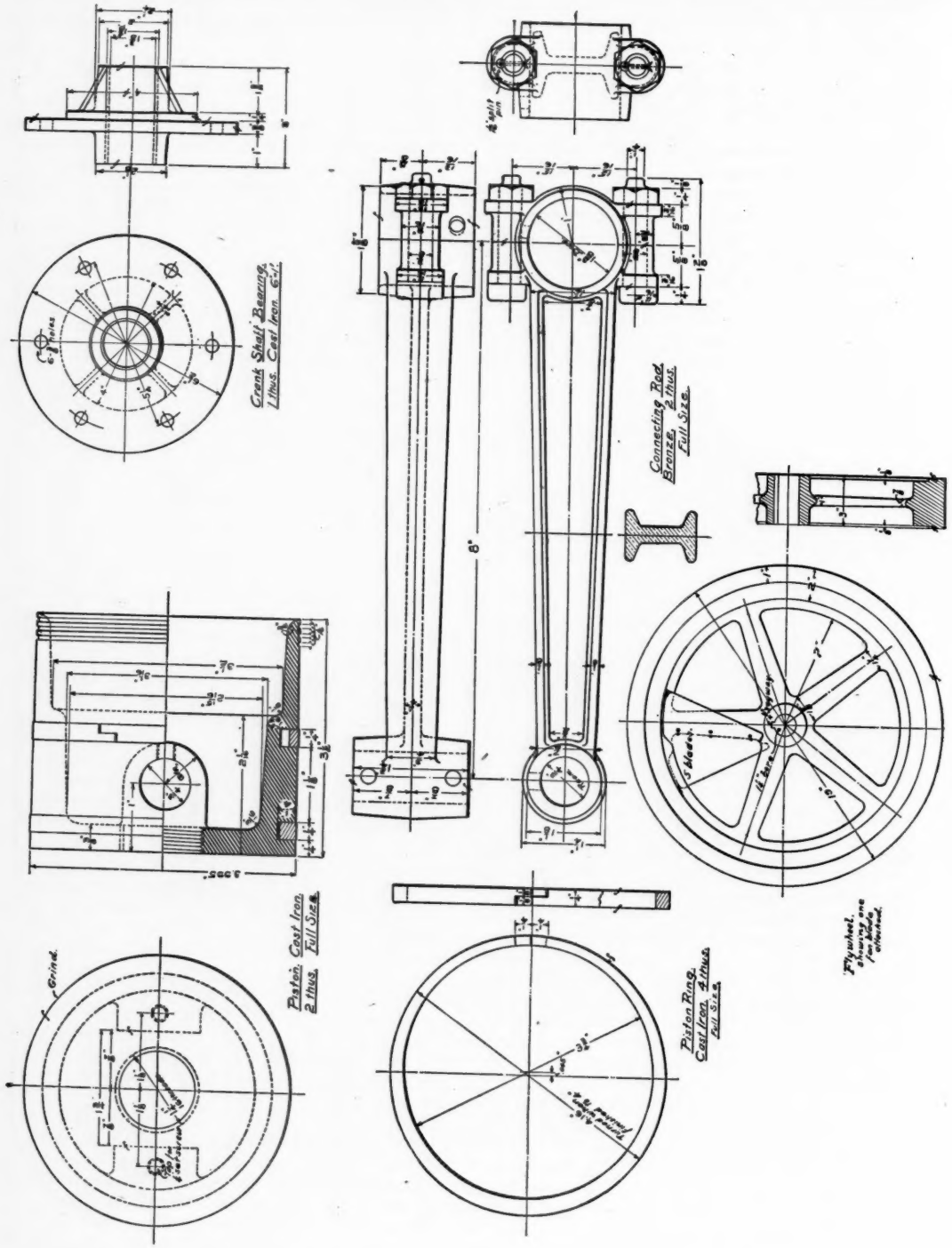
The rings need little description other than that they are sweated together after the bayonet joint is made and strapped to the face plate. The outside is then turned to exactly 4 in. in diameter. and after the joint is heated and springs apart, all solder is wiped off. The ring will be found to fit the cylinder perfectly. The sides are then filed perfectly smooth and true and the ring fitted in the slot. They should be a snug fit, but not so tight as to prevent any movement. Carefully spread the ends and slip over the piston, sliding them down until they "snap" into the grooves.

The connecting rod may be bored by strapping it to a block fastened to the lathe carriage and using a boring bar. The crank pin end is first drilled and the bolts fitted. Then the split is made, the adjoining surface filed very smooth and the cap bolted on. The boring may then be proceeded with, exercising great care to keep the center line of the rod square with the axis of the boring bar.

The crank-shaft is centered on both ends, and the straight portions, and bearings and outsides of the crank webs finished. Two 4½ in. flanges are then turned up (or two pieces of iron, 4 x 2 x 1 in.) on a 1¼ in. arbor. A center is then drilled in each exactly 2 in. from the center of the hole. and a set screw provided for fastening the flanges to the shaft.

These flanges are then forced on the ends of the shaft with the two centers in line with the center of the crank pin to be turned, and securely fastened by the set screws. The shaft can now be put on the centers, and the pin turned. afterwards turning the flanges through 180° for the opposite pin. Wood sticks placed between the crank webs and flanges will prevent the


Bill of Material.
No. Quantity Name.
1 1 Crank Shaft.
2 2 " " Bushings.
3 4 Valve.
4 4 Valve spindle cap
5 4 Valve tappet cap.
6 2 Piston plug.
7 4 Valve tappet.
8 4 " " bear. cap.
9 4 " " " bearing
10 4 " spring
11 4 Tappet "
12 4 Crank case cover stud.
13 6 " " " nuts
14 6 Tappet support
15 2 " studs.
16 4 Wrist pin
17 2 Connecting rod bolts.
18 4
1 hole for pin.
Crank Shaft
Forged Steel.
Finish all over.
6" c.l.
4 of cylinder
Bushings.
Brass.
Valve Steel.
Finish all over.
20 thds.
Grind.
Hardn.
Top for 20 thds.
Steel
Valve spindle cap.
Top 16 thds.
Smooth finish.
Steel
Valve Tappet cap.
16 threads.
Bronze
Piston Plug.
Valve Tappet
Tool steel Finish all over.
16 thds. U.S.S.
Valve Tappet
Bearing Cap.
Steel (tool)
Finish and
Harden.
Tappet Bearing
Bronze.
Spring steel wire.
Valve spring.
Tappet spring.
Tap Bolt List.
No Size Length under head Length of thread For.
12 3/8 1 1/2" 1 1/4" Cylinders to case.
6 3/8 1 1/2" 1/2" Crank shaft bearing
4 5/16 2 1/2" 1" Valve chambers.
1 3/8 2 1/2" 1"
1 1-8 1 1/16 5/8" Cylinder head stay.
18 1-8 5/16 Ya" Pipe flanges.
4 1-4 Sat screws Wrist pin.
4 1-16 Cotter pins Connecting rod bolts
12 3-8 Case hardened nuts.
Crank Case Cover Stud. Steel.
1/2" tap.
Hardened and Ground.
Wrist pin.
Studs for 15.
Valve Tappet support
Steel.
Finish all over.
Connecting Rod Bolts.
Nickel Steel.
split pin.
Tappets.
3 thus Tool steel.
11"
Tappet Shaft. Cold rolled shafting. 1 thus.
J-25-06


Crank Shaft Bearing. 1 thus. Cast Iron. Full Size.
Connecting Rod. Bronze. 2 thus. Full Size.
Piston. Cast Iron. 2 thus. Full Size.
Piston Ring. Cast Iron. 4 thus. Full Size.
Flywheel. Shown as one spoke, the others alternate.

pressure of the center distorting the shaft. When finished, mount in the center rest and bore the hole in the end to take the journal of the clutch shaft. A $\frac{5}{8}$ in. hole is drilled in the opposite end for a pin to engage with the starting lever jaw.

The smaller details need no description. While many of the parts are marked "tool steel," this is not absolutely necessary, as machine steel may be used and the wearing surfaces case hardened. In making fits always make them as good as you can, because the life and power of an engine depends greatly upon the quality of the workmanship.

The bearings of the crank shaft and crank-pins should be very carefully polished with fine emery powder and oil on a leather strap that can be tightly pressed against the revolving bearing.

A MUSIC CABINET.

JOHN F. ADAMS.

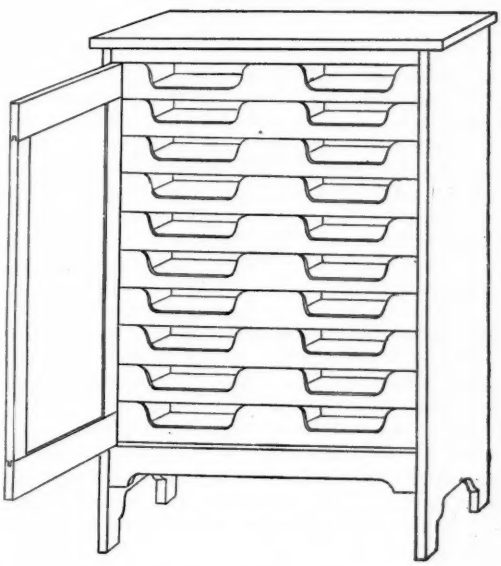
Many musicians, and especially teachers, accumulate a large stock of sheet music, for the proper storage of which no suitable piece of furniture can be found on sale by furniture dealers. The usual music cabinet has a few shelves, but to select any special piece requires that all on the shelf be taken out and looked over.

In the cabinet here illustrated and described, the arrangement is such that a selection may be quickly made and as readily returned to the proper place. This is accomplished by having ten shallow drawers with center division, giving twenty compartments in which the music is alphabetically arranged as in a letter file. If preferred, one half can be used for vocal music and the other for instrumental, in which case two or three letters are assigned to each division, and pieces of binders' board (or heavy cardboard cut from boxes) used to separate each letter in a division, the front of each being lettered. A suitable classification, to suit the particular needs of the user, will readily suggest itself. The wood and finish should be that which will harmonize with the instrument near which it will probably be placed.

The top, 27 x 18 x $\frac{3}{4}$ in., will have to be glued up from two pieces, care being used to get a good match of the grain. The two side pieces are 38 x 17 x $\frac{3}{4}$ in., and will also have to be glued up. The lower ends are cut out to an ornamental scroll, the space to the highest part being 5 in. A pattern should be made of cardboard and left with the order for the stock; the sawing out can then be done on a band-saw at small expense. The same should be done for the front piece under the drawers, which is 25 in. long, 3 in. wide at the ends and 2 in. at the narrower part, and $\frac{3}{4}$ in. thick, which allows $\frac{1}{2}$ in. at each end for tenons to fit into mortises cut in the side pieces.

Much labor can also be saved if the fronts of the drawers are sawed out at the mill. These measure 24 in. long, 3 in. wide and $\frac{1}{2}$ in. thick. The center part is 15 in. long, the openings on each side are 6 in. long and $1\frac{1}{4}$ in. deep. The correct curves can easily be sketched out by making a full-size pattern of thick wrapping paper.

At the back and on a level with the cross-piece under the drawers, is placed a strip 25 in. long, 3 in wide and $\frac{3}{4}$ in. thick, the ends having $\frac{1}{2}$ in. tenons fitting into the side pieces. The upper, outer edge of this piece, the inner, back edges of the side piece, and under back edge of the top should have $\frac{1}{2}$ in. rabbets to receive the back sheathing, which is $\frac{1}{4}$ in. matched sheathing. The top edge of the front cross piece under the drawers is 8 in. from the floor. A cross piece 25 in. long, $1\frac{1}{4}$ in. wide and $\frac{3}{4}$ in. thick with $\frac{1}{2}$ in. tenons is placed flush with the top of the sides. The top is then attached with screws cornered in, countersinking



for the heads. The runs for the drawers are 15 in. long and $1\frac{1}{2}$ in. square, fastened to the sides by screws, the heads countersunk, and are spaced 3 in. apart, beginning at the bottom to mark off, the first one being flush with the upper side of the lower cross piece.

The drawers are so made that the front projects $\frac{1}{2}$ in. below the sides, thus concealing the ends of the runs. The ends of the fronts are rabbeted for the side pieces, which are 15 in. long, $2\frac{1}{2}$ in. wide, except those for the lower drawer, which are 3 in. wide, and are $\frac{3}{4}$ in. thick.

The rear ends are rabbeted on the inner side for the back piece. A ¼ in. groove is cut ¼ in. above the lower edges of the ends and back, and ⅜ in. on the front, for receiving the board forming the bottom. Grooves are also cut in the centers of front and back piece to take the ends of the center dividing piece, which is 14¾ in. long, 2 in. wide and ¼ in. thick. By driving wire finish nails into the bottom and center division piece a rigid drawer is secured, which is needed, owing to the heavy weight of the contents. The edges of the openings are rounded off slightly and carefully smoothed with sandpaper to give a better finish and make the handling of them more satisfactory.

An ordinary panel door, 30 x 24 in. is made for the front, the rails being 24 in. long, 3 in. wide and ⅜ in. thick, allowing ¼ in. tenons on the ends. A ¼ in. groove is cut at the center of the inner edges to receive the panel, which is 24½ in. long, 19½ in. wide and ¼ in. thick. This will have to be glued up from two pieces, and a nice match made of the grain. This should surely be looked after, as a poor match would injure the appearance greatly. The door is hung with two brass hinges, fitted with lock, and a brass pull knob and key-hole plate on the outside.

A NEW GLOW LAMP.

It is credited to electric lighting, even by its worst enemies, that it has made the gas people wake up. The gas lamp has been much improved, and as the process has gone on there has been evidence of a reaction on the newer light. It will be remembered that in the beginning of electric lighting all the efforts of electric inventors were concentrated on the problem of producing a decent lamp. Then came a time when the carbon glow lamp was accepted as practically perfection, and the efforts of engineers were devoted to the cheapening of the production and distribution of electrical energy. Once again the pendulum has swung back, and the market is full of new lamps, and the tale of new lamps. The last example comes from Germany and threatens to be a formidable competitor of those established or seeking establishment. The Siemens & Halske Company has been for a long time engaged in an endeavor to improve the electric light at a place where there is the greatest room for improvement, viz., the hopelessly inefficient glow lamp ; but the matter has been kept very quiet ; indeed, the first publication was made at a meeting of the Berlin Elektrotechnischer Verein, on the 17th ult., when two papers were read by Mr. O. Feuerlein and Dr. von Bolton. The papers, and the communication of Mr. W. von Siemens are reproduced in the "Elektroteconische Zeitscrift " of January 26, with illustrations of the lamp and filament. There is, therefore, no longer any secrecy about the matter, and indeed one may expect to find the lamps upon the market almost immediately.

The new lamp has a metallic filament and, in fact, appears to constitute a solution of a problem to which Mr. Edison originally set himself without result. Undeterred by his failures the Siemens & Halske Company, some very considerable time ago, set Dr. von Bolton to work on the task of finding a substance capable of being drawn into a filament, and having a melting-point so high that it would give a white light before failing. What Dr. von Bolton has done is to ransack the unused elements, and it seems that he has found what is wanted in tantalum. All that is known by most people of the properties of the so-called rare elements is the descriptions of them at the end of the chemistry books. These are mostly wrong for the simple reason that the things have been prepared once or twice by men who were not metallurgists, under circumstances of considerable difficulty, and without hope of any commercial gain which would justify the expenditure of time and money in purification. Of the two standard ways of getting anything which resists ordinary methods of reduction, the electric furnace invariably involves pollution with carbon. Electrolysis of the fused salt belongs rather to an element of a low melting point, and everyone knows the difficulty of getting a pure deposit. In fact, to draw any conclusions from the descriptions of the unused metals that appear in the books is very much the same as if one were to argue on the electrical possibilities of Fe from a small specimen of cast iron. Dr. von Bolton, in the course of his researches, tried vanadium, and found its melting point (as indeed he should have had fair warning, was much too low. The obvious course was then followed of trying the remaining elements of the same class—first niobium and then tantalum. The tantalum he has obtained is an entirely different substance to the tantalum of the books.

Pure metallic tantalum resists acids like platinum. It will burn in air, so that the lamp must be run in a vacuum ; it absorbs hydrogen, nitrogen and carbon. Consequently, the tantalums that we have been put off with hitherto, though metallic in appearance, were really compounds or alloys. The tensile strengh of pure tantalum is 25 per cent. better than steel. It can be drawn into wire and it has the property which is so valuable in soft iron, viz., that it becomes malleable long before it actually melts.

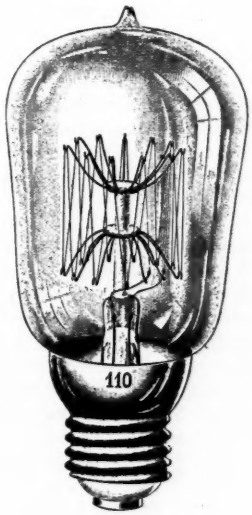
Its electrical properties are even more convenient ; the resistence of a meter wire of one square millimeter cross section is .16 ohms, but when run at its working temperature the resistance rises to .83 ohms, (say five times as much). Metallic tantalum has, in fact, as becomes a metal, a strong positive temperature coefficient. The ordinary carbon filament is, as is well

known, deficient in this respect, though not (when at the temperature of incandescence) to such an extent as to make special treatment necessary, but the negative coefficients of the Nernst and of the arc constitute an effective nuisance.

The chemical difficulties of the manufacture of tantalum, which are not very serious, being removed, the mechanical problem remained of constructing a glow lamp that should have a filament two or three feet long, so as to run at a reasonable voltage, and this part of the work was out by Mr. Feuerlein. How the difficulty has been overcome will be seen from the illustration of the filament given herewith. The wire is looped round and round on a kind of frame. All metallic filaments are necessarily low resistance filaments, but it will be seen that, after all, there are compensations in working in metal instead of in carbon, or in a brittle paste of oxide. The type of lamp is already standardized for 110 volts 24 candles, and this lamp has a consumption of 1.6 watts per c. p. The filament is 25 inches long and has a diameter of .05 millimeter. As the weight of it is 22 milligrams, a pound of tantalum will make more than 20,000 lamps. The life of the lamp is about 500 hours, till at 1,000 hours it becomes a 2½ watt lamp. It is, therefore, quite possible that it may end as the 1,000 hour lamp that we are used to. It will be seen that the consumption renders the lamp an immediate competitor of the Nernst and the small enclosed arc. Its great point is that, like the osmium lamp of Dr. Auer von Welsbach, it contains no mechanism. The physical, as apart from the economic end of the lamp's life, appears to come when the wire becomes mis-shapen and brittle. Repeated expansion and contraction results in a shortening the length of the filament and a roughening. The new filament is quite tough, but old lamps should not be taken out or shaken (as with the gas mantle). Curiously enough, a broken lamp can frequently be mended by a simple process of tapping it until the loose ends touch together, when they weld themselves together. It then, of course, goes on as an over-run lamp. A similar habit was promised for the Nernst burner, but nothing came of it, and it seems unlikely that this auto-repairing faculty will come into practical use. The appearance of the filiament has already been illustrated; it merely remains to add that it is inclosed in a vacuum bulb in every respect similar to that of the glow lamp of commerce. The limits of the voltage and size mentioned do not seem in any degree fixed. It is possible that they may be capable of considerable extension, but at present only 100 to 120 volt 24 c. p. lamp can be procured.

After the reading of the papers at Berlin some additional information was given by Mr. Wilhelm von Siemens; but except for the opening remarks of the chairman, Dr. Micke, there seems to have been no discussion. Beyond appreciation of the labors of Dr. von Bolton and Mr. Feuerlein, the important part of Mr. Siemen's speech was a declaration that the lamp was quite ready. The development has been done without any preliminary writing in the newspapers, and not a word has been said about it untll the company has not only got a lamp that will go, but is ready to go on turning them out for the market at the rate of 1,000 per day. Specimens of the present pattern have been running for a year.

There remains one point upon which the tantalum lamp is somewhat tantalizing; there is no information in the paper upon price. As regards the osmium lamp, with which one naturally compares it, when its producers have been asked whence they are going to get their osmium, they have replied in terms which, translated out of the language of politeness amount to



"That's our business; we have got it." At the same time, one naturally wants to know in what quantity. There is this about tantalum, that, although supposed to be a rare element, it exists in a quite sufficient quantity, even if no fresh discoveries are made, to provide the material of glow lamp filaments. That difficulty is no more likely to arise than in the case of finding sufficiency of the elements of the cerium group to make Welsbach mantles. And when manufactured in quantity there seems nothing in the process of production which should make it a matter of physical necessity that the new lamp should be excessively dear. It appears that the metal is reduced from the double fluoride of potassium and tantalum substantially after the manner to be found in the books. The impossible looking powder thus obtained when heated electrically under the air pump, parts with the gases it has absorbed during the process of manufacture, and fuses into a workable metal—*Electrical Times, London.*

Renew your subscription before you forget it.

PHOTOGRAPHY.

GUM=BI=CHROMATE PRINTS.

JAMES E. MASTERS.

We hope this article will lead many of our readers to try their hands at gum-bichromate.

Gum-bichromate would seem in theory the simplest of printing processes, but in actual practice it will be found to be the most difficult. Prepared according to the method about to be described, it certainly has the advantage of cheapness. This latter quality is not one to be generally recommended, but in the case of the beginner in gum printing, who is almost certain to waste plenty of material during his early efforts, anything tending in the direction of economy is worthy of consideration. If the reader decides to prepare his own paper, his total outlay for the necessary equipment need not be more than sixpence. The materials required will be a brush for coating—a one inch flat hog hair brush will answer perfectly; an ounce of potassium bichromate, an ounce of gum arabic, and a sheet of cartridge paper.

The bicromate should be made up in a saturated solution, and the ounce of gum dissolved in 2½ ounces of water and then strained through fine muslin, in order to remove all impurities. The paper to be coated should be a little larger all round than the actual size required, and it will be found that the penny sheet of paper will be cut into nine pieces, each allowing ample margin for whole plate size.

Before coating, it will be well to place an old negative on the paper and run round the edges with lead pencil. This will ensure the requsite surface being covered, and will also be a guide as to whether the coating has been done properly.

The best pigment to start with is lamp-black, and instead of wasting money buying this, the writer scrapes a little as required from the inside of his dark room lantern. To coat the paper, mix equal portions (say ½ ounce) of the bichromate and gum solution in a measuring glass, take an old negative or a piece of opal, place a small portion of the lamp-black or soot in the center, and with a few drops of the gum-biehromate mixture, grind with an old palette knife or a worn out and flexible table knife. When the pigment is well ground up it should be removed by means of the knife to an old saucer, and thinned down to the proper consistency with some of the remaining bichromate and gum solution. I never weigh out any definite quantity of pigment, but after grinding add the gum and bichromate till I instinctively feel that the mixture is of the right consistency. The point at which the beginner nearly always goes wrong is in including too much pigment. This should be distinctly guarded against, and, instead of aiming at mixing an intense black liquid, the gum-bichromate solution should be added till the mixture is rather thin and easily workable with the brush. The right point will be reached when the pigment solution is of a slightly transparent greenish black color, which will allow the pencil marks on the paper to show through quite distinctly. After one or two trials, the beginner should experience no difficulty whatever with this part of the process.

For coating, the paper should be pinned down at the four corners to a board, and the sensitive pigmented solution applied by means of the brush. A good brushful should be sufficient to coat a whole-plate piece, the brush being worked backwards and forwards both ways of the paper till a thin and fairly even coating is obtained. By this time the paper will have expanded slightly, and the pins should be removed from the corners and the sheet again pinned down. The coating, when dry, should appear fairly even and of a greenish tint; should any slight streakiness be observed, it can be ignored, as it will not be evident in the print after development.

Printing takes about the same time as that required for carbon, and a soft and thin negative is best for the process. If an actinometer of some description is used no difficulty will be found, after one or two trials, as regards exposure.

Development is effected by floating the print face downwards in a dish of cold water. It will be best at first to immerse the print face upwards, and after seeing that no airbells have formed, the print can be floated face downwards on the surface of the water and left till development is complete. If exposure has been approximately correct, development will proceed automatically, and may occupy anything between twenty minutes and two or three hours. In the case of over-exposure, the use of warm water will help matters considerably.

Using lamp-black as I have recommended, the resulting print will be of a pleasing brownish black color suitable for most subjects ; but should the reader desire a greater variety, he can gratify his taste by procuring tubes of moist water-color of the requisite tints, and using them in place of the lamp-black.

The Photo-American.

PHOTOGRAPHY NOTES.

TO SENSITIZE PREPARED ARTIST'S CANVAS FOR SILVER PRINTING.

As a rule the surface of this is very greasy, and it is advisable to gently rub it over with a pad of cotton-wool dipped in weak solution of ammonia till it no longer appears greasy. The best method to sensitize is to use a gelatino-chloride emulsion, or the following is simpler:

Ammonia chloride	100 grs.	20 grs.
Gelatine	30 grs.	6 grs.
Water	10 ozs.	1,000 c. c.

Soak the gelatine for half an hour, then melt in a water bath and add the chloride. Keep at a temperature of about 100° F., and then with a varnish mop coat the canvas with an even and fairly thick coating. Keep the canvas level, and allow to set and dry. When dry use a broad, flat brush and paint fairly thickly with

Silver nitrate	50 grs.	100 g.
Water	1 oz.	1,000 c. c.

dissolve and add

Liquid ammonia fort .880

till the precipitate first formed is redissolved. Brush this evenly over the surface and dry, and it is ready for printing on; but when sensitized it will not keep more than 36 hours.—*Photo-American.*

WRITING ON BLUE PRINTS.

Those who occasionally print by the well-known ferro-prussiate process, as well as engineers who copy tracings by this means, may make a note of a rapid and easy method of writing details on such prints. A solution of carbonate of soda or caustic soda, frequently recommended for the purpose, is not nearly so good as one of potassium oxalate. The uniform strength of solution is important, though why a variation in the strength of such a neutral substance as potassium oxalate should make any difference I am unable to say. However, 75 grains dissolved in an ounce of water will remove the blue ground of the drawing in a few seconds, and can be applied with a pen or fine brush, the solution, if necessary, being thickened with gum. The paper should be well washed afterwards, for, if this is not done the blue color is very likely to reappear. Engineers who use this method on large tracings frequently content themselves with mopping off the surplus solution with blotting-paper and "washing" the treated part by applying wet blotting-paper once or twice. This imperfect method of removing the chemcals is, no doubt, responsible for the complaint made in many engineering shops that details written in this way gradually disappear from the drawing, the blue ground being gradually restored.—*Photo-American.*

THE OHM.

OSCAR F. DAME.

Electricians speak of a coil of wire measuring 3 ohms, or an electric incandescent lamp measuring 660 ohms, and the term is such a common one that many amateurs use the word without really comprehending its exact meaning. Mr. Ohm was an electrical experimenter whose researches in electrical matters, especially in relation to the laws of current flow, caused his name to be given to the unit of electrical resistance.

When a current of electricity is passed through a conductor, the conductor offers a resistence of obstruction to its passage, and the amount of current that passes in every instance will depend on the magnitude of this resistance. The resistance of a conductor varies directly as the length of the conductor; inversely as the area of cross section, and also upon the kind of substance composing the conductor. Simplified, this means that a piece of wire of a given gauge, seven in. long, will have seven times the resistance of a piece only one in. long. The larger the conductor the less the resistance, is illustrated by noting that a foot of No. 16 gauge wire has much less resistance than a foot of No. 36 gauge. We also learn that some metals are not such good conductors as others, and consequently a given gauge of copper wire and iron wire will have different resistances. All kinds of metals, therefore, have a factor of resistance used in calculations. When we know the length of a copper wire in feet and its diameter in mills, we can multiply the standard coefficient of copper, 10.18, by length in feet and divide this by the diameter in mills, squared, and get the exact resistance. For example: No. 36 copper wire is 5 mills in diameter, and to find the resistance of a piece 1000 ft. long, we have 10.18 times 1000 divided by 5 squared equals 407.2 ohms.

Ohms law explains that a unit of resistence depends upon certain relations existing between current and electro-motive force. Ohm found that when a current was passed through a wire or other conductor, the relation which existed between resistance current and electro-motive force could be expressed:—

$$\text{Current, (Amperes)} = \frac{\text{E. M. F.}}{\text{Ohms}}$$

The correct difinition of an ohm, may therefore be as follows:

An ohm is that resistance through which a pressure of one volt will cause a current of one ampere to flow.

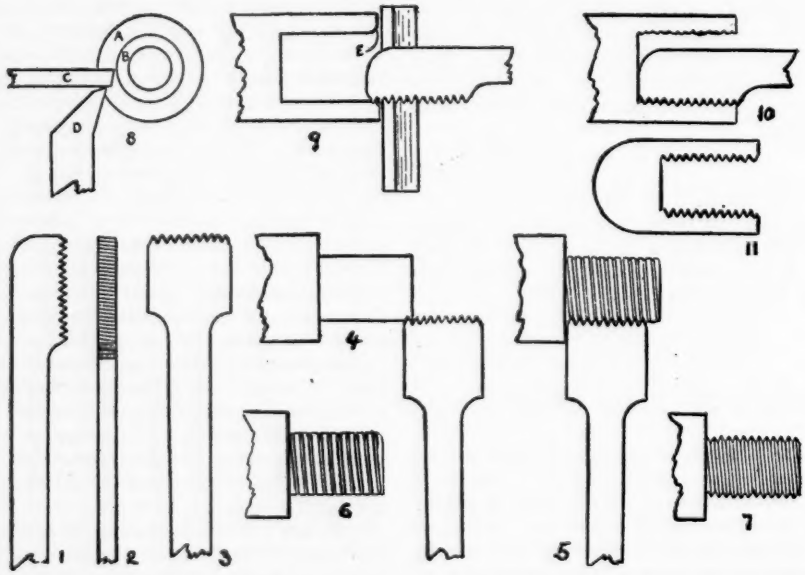
The catalogs of many manufacturers and electrical supply houses contain tables showing, among other things, the resistances of copper wires of all gauges by the pound and foot, also the diameter of these gauges in inches and mills and the number of feet in the pound.

Every amateur mechanic who wishes to keep posted should regularly read AMATEUR WORK.

SCREW CHASING IN WOOD.

HENRY JARVIS.

The chasing of inside and outside threads in the lathe is a task essayed by a great many amateurs, but their work is often attended with very poor results, the cause usually being either that they do not go the right way to work, or that they have not sufficient perseverance to survive the first failure. Now there is no reason whatever why one and all should not be successful in screw chasing, the necessary appliance being few and cheap and the experience required being very little.



First as to tools required. These consist of one or more pairs of chasers (one for the inside and one for the outside screw thread) which must be of such a pitch as to suit the work in hand. A good size for a beginner is sixteen or eighteen teeth to the inch, which will cut a thread suitable for small boxes. It is well not to commence with either very fine or very coarse work.

The shape of the inside chaser is shown in Fig. 1, and a front view of the same in Fig. 2, while Fig. 3 shows the outside tool. The teeth of both the inside and outside tools are made at an angle, as in Fig. 2, to suit the pitch of the screw they will cut; they are also made at a slight angle with the side of the tools, so as to give the necessary clearance.

For the sake of illustration we will suppose that a small box has to be provided with a screw-on lid and that it is already turned up to the proper sizes, ready for chasing. This is commenced as in Fig. 4. The box must be held in the lathe in a chuck, or if too long for this, a mandril can be fitted into the opening, to enable it to be mounted between the centers. The outside chaser is held flat on the rest and fed up to the box, so that the first tooth will just catch in the wood; and if the lathe is turned very slowly, the beveled teeth of the chaser will draw themselves evenly and truly, until the side of the tool touches the shoulder of the box, as in Fig. 5.

If this has been done and no slipping has occurred, the wood will now be as in Fig. 6, the threads of the screw being represented by slight cuts only, scarcely more than scratches. The same process must be repeated, deepening the scratches slightly, as in Fig. 5, and gradually going over them again and again, until the finished result is as Fig. 7.

The tool will be found to work best if the cutting part is on an exact level with the lathe centers, as in Fig 8, where *A* represents the body of the box, *B* the reduced part on which the screw thread has to be chased, *C* the chasing tool and *D* the rest.

Now for the inside chasing, which will be found the most difficult to do. The box lid must be mounted truly in a chuck of some description, and the rest fixed close up to it, across the end as in Fig. 9. The opening should be chamfered slightly at *E* to enable the tool to start easily, and the tool is then placed so that

it will just bite at the commencement, when it should draw itself along, making a slight thread only, but the same depth throughout, until it reaches the end of the opening, as in Fig. 10. The thread must be gradually deepened in the same way as before until it is cut to the full depth as in Fig. 11, or until the first part will easily screw into it. As it approaches the finish it is necessary to frequently try this, or the lid may be spoilt through making it too large.

All this looks very easy on paper, and it looks nearly as simple to watch an experienced person doing it, but for the novice there are many pitfalls which it will be well to describe so that they may be avoided. The first risk lies in taking too deep a cut, this having the same effect as in ordinary fine turning, tearing the work about and throwing it out of the center and causing a general upset. The remedy is obvious. Use the tool carefully. Another fault is running the lathe at too high speed ; this causes all command over the tools to be lost, and when the shoulder is reached, so that the tool can go no further, it cuts off the threads already made. The remedy is to run the lathe as slowly as possible, even to dispense with the treadle and turn the mandril by hand; or to borrow the serservices of an obliging friend to do so, at least during the first stages of experimenting with the tools.

Another very frequent fault with beginners is allowing the tool to draw itself in or out, after starting at the proper depth. This is caused through not holding the tools parallel or at right angles with the work at the commencement. It is easily rectified in the outside tool, but the fault is not apparent in the inside one until the mischief is done, hence care is required in this respect.

Another mistake often made, especially by novices, is to turn the two parts so that they fit one in the other before the threads are chased, so that when the latter is done the lid is of course too large for the other part. For threads of the size mentioned above, about an eighth of an inch should be allowed ; it need not be done to any exact size, as it is easy to take an extra cut if the parts fit too tightly.

It is always best to chase the outside thread first, as this can then be fitted into the other as required, without disturbing the center. And it is as well to chase the inside thread while the wood is mounted on the original chuck, cutting the lid off and finishing after the thread is cut. When a very short screw is wanted, it should be cut off to the length after chasing, as it is much easier to make a screw of say an inch long, than it is one of three or four threads only ; in fact, it is as well to always allow for cutting off a short length at the end of a thread, as it then makes a clean finish, or rather beginning, which is not always the case when the turning is finished to length before chasing.

When using either the inside or outside tool, it must be held quite straight with the work and also perfectly horizontal, as shown in the drawing (Fig. 8) the latter especially being very important. Do not attempt o chase screws on very soft wood ; a close, hard-grained wood is the best, especially for trial.

If all the points here mentioned are attended to, there should be no difficulty in turning out good screws, but if any one is neglected, failure will certainly result.—*Hobbies, London.*

Some comparative tests between twist drills made of ordinary tool steel and of their ".0172" high-speed steel have recently been carried out at the works of Messrs. Cammell, Laird & Co., Coventry, Eng. Each drill was ¾ in. in diameter, the ordinary steel costing 2s 7d net. The former was run at 32 ft. cutting speed per minute, and in 40 minutes drilled 36 holes through a high-carbon steel-plate 1¼ in. thick, and then required grinding. The operation was then repeated until 3600 holes in all had been drilled, when the tool was too short for further use. With the ".0172" steel drill the machine was speeded up to give a cutting speed of 60 ft. per minute, and on exactly similar material 150 holes were drilled in 80 minutes, when the tool was reground, although in better condition than the other when the latter had drilled 18 holes. After drilling 3600 holes the drill was still far from worn out, but, allowing the same life to each drill, the firm estimates the total cost of drilling 15,000 holes at $59 for the ordinary drills and $26 for their high-speed drills.

A short time ago Messrs. Witherington & Sons, millers, of Reading, England, made a comparison between the cost of carriage by steam motor and that by horse-drawn vehicles. In 1602 they had seven horses, and the expense of them for the year was $2,530.58. At the end of 1902 they sold the horses and purchased a steam machine, ran it 5272 miles, carried 3370 tons and burned 41½ tons of coal, at the total cost of $1,8849.27, including interest on the original car and also depreciation.

A German paper states that artificial rubies have been produced in France by reducing small natural rubies into a very fine powder, which is melted in an electric furnace, cooled rapidly and crystallized. The product obtained, from what was of little worth on account of minuteness, possesses a comparatively high value. The main difficulty encountered is to prevent cavities and fissures in the crystals. The new process can not be employed with emeralds and sapphires, as they become discolored by the action of the heat.

An indication of the immense business being done in the iron trade is the congestion of the tracks by cars loaded with the products of the mills in the vicinity of Homestead, Pa., and other manufacturing points. In one yard there were six miles of cars waiting movement one day in the early part of last month.

AMATEUR WORK.

DRAPER PUBLISHING CO., Publishers,

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A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instruction of the amateur worker.

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Single copies of back numbers, 10 cents each.

TO ADVERTISERS.

New advertisments, or changes, intended for a particular issue, must be received at this office on or before the 10th of the previous month.

Entered at the Post Office, Boston, as second class mail matter, Jan. 14, 1902.

MARCH, 1905.

In this issue will be found the first chapter of the description of the Amateur runabout, which was announced in the previous number. The writer claims but little originality in the design and wishes to express his obligation to those who are so kindly assisting in supplying the necessary information. The principal objects in view are to supply a serviceable car at the lowest possible cost consistent with durable construction. The various sources of supply for parts are being investigated, and several fixtures are being made up special, that those building from this description may be able to get supplies of up-to-date design and yet at low cost. As many questions are likely to arise, special attention will be given to correspondence regarding same, by this means giving readers all the data necessary to intelligent progress with the work. Suggestions will also be gratefully received. We confidently believe this to be the first practical description of a motor car to be published in this country, and that it will be welcomed by a wide circle of readers.

The addition of a number of new and desirable premiums to our list has delayed the issue of same till the next issue. We hope to have it fully completed for that issue.

The reprint and binding of all the back numbers is about completed, and it is expected that all orders for bound volumes will be filled by the time this magazine is delivered.

Photography is one of the most valuable means of record, and its uses for this purpose is extending into all departments of engineering and mechanical work. A photograph tells its story at a glance, and when dated and supplemented with written notes a series of views makes the best possible record of progress. The cost of making photographs with a proper equipment is not a great expense, and any bright young man can learn to make exposures, develop the negatives and make the prints in a few days. To insure accuracy as to the dating it is a practice to set up a small blackboard in the foreground with the date chalked in large letters thereon. Whenever a special job is done a picture should be taken of the set-up of the machine and of the successive steps taken in the operation. It will often be of material assistance afterward to be able to show just how a certain job was done and what tools were used. In a case of accident or breakdown a record may be of great value, and cases are known where a good picture has been the principal and deciding evidence in a damage suit. With a high-grade lens tracings can be photographed in greatly reduced scale without distortion, and prints made from the negatives may be used in the shop much more conveniently than the large, cumbersome blueprints. Lines and dimensions, although of microscopic size, will stand forth with great distinctness even though the tracing is photographed to a scale, say, one-sixth or less of the original size. In fact the usefulness of the camera in the average shop is only limited by the enterprise of those responsible for its application.

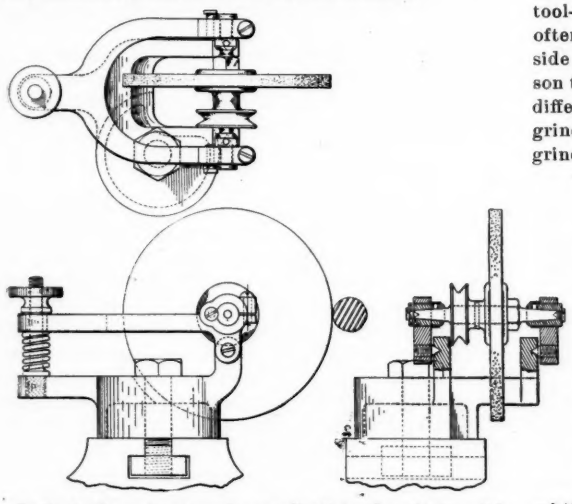
In looking up with criticism or admiration at a modern office building probably the last question which would suggest itself to the observer is "how much does it weigh?" The mind can hardly realize the significance of figures in this connection, and yet it is not uninteresting to read of a close estimate of the exact weight of an up-to-date metropolitan steel structure, including the entire contents. The aggregate weight of one just built for the New York *Times* has been declared as 81,913,000 pounds. Of course the actual weight of a large part of everything used in its construction is known to the contractors who handle and bill it, as for example, the structural iron, which weighed 7,021,000 pounds.

TOOL MAKING FOR AMATEURS.

ROBERT GIBSON GRISWOLD.

VII. A Grinder Head for a Lathe.

To the amateur, fond of doing fine mechanical work, there is nothing that appeals so strongly as a finely finished piece of work or an absolutely accurate fit. But such accurate work demands very accurate tools. The ordinary lathe tools are not capable of doing very close work, especially when the finish is made with a file: but if work is finished to within .003 of an inch with a tool and then brought to size by grinding, a very accurate piece of work may be obtained.



In fact, there is scarcely any limit to the nicety with which a definite size may be obtained on cylindrical forms, and one may, with a little practice, come within .0001 or .0002 in. of a given size, while an absolute diameter, as measured with a micrometer, is quite as readily obtained.

Most of the grinding done in commercial lines is accomplished by means of special machines, the truth and accuracy of which is almost beyond criticism. But if the ways of a lathe are in good condition a very fair class of work may be done, and far ahead of any hand finish that can possibiy be given. The thought generally arises in the mind that grinding is a slow and tedious process, but in all probability this is due to the fact that the wheel apparently removes little material at a time. But such thoughts are fallacies. A perfectly true-to-size piece may be secured in far less time by grinding than by any other method, and that with absolute certainty as to its being straight.

Most of the appliances used in lathe grinding are more or less crude, especially what is known as the "tool-post" grinder. This is through no fault of the no fault of the machine, but due to an accumulation of possible errors. In the first place, the cross feed screw of any lathe is not fine enough to secure cuts varying from .0001 in. to .0005 in., and unless this is possible little can be done towards really accurate work. Then again, the wheel is generally overhung on parallel bearings, seldom adjustable. In grinding to a shoulder, parallelism of the wheel with the plane of the shoulder is dependent only on the accuracy of the tool-post seat and bottom of the grinder stock. Too often the grinder is made interchangeable with an inside grinder; this should never be, for the simple reason that the requirements of the two are so entirely different and the speeds so varying, that of an inside grinder being fully five to ten times that of an outside grinder. The bearings required by the two shifts are very different.

Another feature that is absolutely essential in any good grinder is rigidity, and that can hardly be possessed by a greatly overhung wheel supported by a simple fork, as generally used in the tool-post style.

The desire to make a grinder head for a lathe that would overcome these bad features has led to the design shown in Fig. 1. Every part has been given sufficient rigidity and weight to overcome vibration, which would result in chattering and a rippled surface on the work. The adjustment of the wheel feed is so sensitive that .0001 in. or less may be very easily secured, while the coarse feed may be had by the carriage screw. The head is also adjustable to any angle, so that surface grinding may be done on the face plate. The wheel is supported on a hardened steel shaft running in hardened steel bushings, thus giving the minimum amount of wear. The bearings are adjustable and carry the tapered journals of the wheel shaft. This adjustment is absolute and the very best that can be secured for such high-speed, and at the same time, light work.

The base is provided with a body that can be trued on an arbor so that it will bear evenly on the tool-post seat. A ball passes through the center into a nut in the "T" slot, a slight turn on which securely fastens the grinder in any desired position. A lug extends from one side carrying the adjustable screw, and a very heavy, substantial fork carries the wheel yoke. The adjusting screw should be provided with very fine threads, say 40 the inch, and the thumb nut should have a spherical seat washer under it to accommodate every motion of the arm, although small. The spring should be of No. 14 piano wire and very stiff. Drill

the cups for the pointed trunion screws very accurately in the lathe. Best done by laying off carefully and then drilling between centers with a very short, stiff drill held in a chuck. Grind the drill to the same angle as the screws, about 60°.

The yoke carrying the wheel spindle is given a form best adapting it to resist the spreading strain of the trunion screws, but as these should be just brought to firm bearing, no great strain need be imposed, as the weight to be carried is comparatively small and the wheel strain very slight. The positions of the various screws are laid off and accurately drilled between centers, as described above. Mount the yoke on its trunions and clamp to the lathe carriage, the base of the head having been so machined as to bring the center of the wheel spindle directly in line with the lathe centers. Then sharpen a ⅜ in. drill and mount in a drill chuck so that it runs perfectly true. Now feed the carriage along very slowly so that the drill will drill a smooth, true hole through each arm of the yoke. This insures the parallelism of the lathe centers and wheel spindle, since the holes have been drilled in place. If a ⅜ in. reamer is at hand, use a drill about 1-64 in. under size and ream the holes true. The adjusting arm should be clamped down tightly on a small block cut to the proper length to hold the arm in its middle position while drilling. The spring might not be sufficiently stiff to keep the drill from "walking". The bearing is now split on one side with a fine saw, and this serves to clamp the bushing firmly in place.

The bushings are turned out of a piece of ⅜ in Stubbs' steel drill rod. The spindle may also be turned from the same, but it would be better, if a very fine job is desired, to make two spindles, mounting the wheels on one finished as nicely as possible by hand and then grinding the other, after hardening, to a true cylinder and the journals perfectly in line. These journals have a taper of ¼ in. per foot. The bearings can be made by reaming out the hole with a reamer turned to the taper of the journal. To make this reamer, turn a piece of tool steel to the proper taper and then file away one side until the flat surface coincides with the center line. This leaves a cutting edge on either side, and it will ream a very smooth hole. Harden and grind on the flat side only.

Harden the bushings and lap the hole out with a piece of copper (held in the chuck) turned to the proper taper and charged with flour of emery and oil. This will give a beautiful surface and the bearing will be truly conical.

The spindle is slightly longer than the distance between the arms of the yoke, owing to the desire te get the supports as near the wheel as possible and this necessitates canting the spindle and putting in first one end and then the other, afterwards inserting the bushings. But as the head is seldom taken apart except for the removal of a broken or worn out wheel, this does not mean much in the matter of time, and it does allow a solid support for the bushing, which is a point greatly to be desired. The head of the adjusting screw bears on one edge of the bushing, and a fine adjustment is secured by screwing these in as wear takes place.

Oil holes are drilled in the top of the bushings and covered with a small ring of brass to exclude dust and small particles of abrasure. A small washer of felt should be inserted in the hole at the end of the bushing, acting as a plug and oil reservoir.

The pulley and clamping flanges need no description excepting that they are secured to the spindle by a spur, the hole for which is drilled in the spindle before hardening. The emery wheel should be about 3 in. diameter and not over 3-16 in. or ¼ in. thick, and what is known as "Grade No. 60 or 70." The speed at which a 3 in. wheel should run is about 6500 revolutions per minute, but on foot power lathes this may be difficult without an overhead shaft and light driving wheel, which will be described in the next chapter.

At that time there will be described an inside grinder and the overhead hangers and shafting necessary for driving the wheels, to be followed by chapter on grinding, selection of wheels, speeds, etc.

"There is no place in the modern world for the unskilled; no one can hope for any genuine success who fails to give himself the most complete special education. Good intentions go for nothing, and industry is thrown away if one cannot infuse a high degree of skill into his work. The man of medium skill depends upon fortunate conditions for success; he cannot command it, nor can he keep it. The trained man has all the advantages on his side; the untrained man invites all the tragic possibilities of failure."—*Hamilton W. Mabie.*

When tightening down a cylinder head or flange after putting in a new gasket, take great pains to screw down the nuts evenly all around. If one side is screwed down too hard there will be a weak spot on the opposite side, or the head or flange may even be sprung. Give each nut a fraction of a turn and keep going around until all are firmly down. Do not, however, make the mistake of putting on too much force and and breaking the threads — not at all difficult to do with a small bolt and long wrench.

Forest Leaves notes that in the making of charcoal the condensible gases from one cord of wood amounts to 224 gallons of liquor. This liquor is known as green liquor or pyroligneous acid. It is largely made up of water but contains also, alcohol, tar, ammonia compounds, acteone (alyl-alcohol, ethers, aldehydes and acetic acid. Alcohol, acetic acid and formalde hyde are the substances usually separated out of the liquor.

HOW TO BUILD A POWER LAUNCH.

CARL H. CLARK.

IV. Framing for Deck.

If the moulds have not been already removed it may now be done, and any nail holes where fastenings have been put in, should be carefully plugged, using a small wooden plug, if necessary.

The tops of the frames, except three at each end, are now cut off even with the upper edge of the top streak. The clamps are 3½ in. wide by 2 in. deep, of hard pine, and are laid with their 2 in. side on the frames, as shown in the cross section. In order that they may bend more easily they may be tapered off towards each end to 2½ in.; if this ½ in. is taken off the outside edge it will aid in giving the clamp a small amount of original curvature. The whole outer edge should also be beveled so that when the clamp is in place it will have a slight slope, so as to match the crown of the deck at the ends. As will be noted, the main clamp extends only the length of the cabin trunk, and at the ends other additional short clamps are fitted. The main clamps extend from the third frame from the bow to the second frame from the stern, as shown in the general drawing. It may even, to good advantage, extend to the second frame, as this will allow the fastening of the end. The clamps may be bent into place when cold, as the curvature is slight, but before bending them in, a double turn of rope with a stick to twist it up should be passed over the tops of the frames at the ends of the clamps to prevent the bulging of the sides of the boat at these joints, owing to the pressure when clamp is bent into place, and at any signs of bulging it may be brought back to shape by revolving the stick, thus twisting the rope and drawing the ends together.

When the clamp is in place it is fastened with rivets driven through the tops of the frames and the top streak. Before fastening, care must be taken that the clamp bears evenly on all the frames, and any which are thicker than the others should be trimmed down; this is necessary, as the clamp, being heavier than the side of the boat will draw the latter to it, and if the frames did not all bear evenly some would be drawn in more than others and the side of the deck would be irregular. The short clamps at the ends are also of hard pine, 1½ in. thick and 3½ in. wide, tapering to 3 in. at the extreme ends. They are bent around flatwise 2 in. below the top of the top streak and, as will be seen, they will just pass under the main clamp, which they should be allowed to do, and extend at least a frame space beyond the end of the main clamp. This avoids a break in the structure of the boat and preserves the strength.

These short clamps are fastened in the same manner as the main clamps, and at the extreme ends, where there are no frames, pieces of board of the same thickness as the frames are placed under the clamps and fastened through. At the bow a knee, or a triangular piece of board, should be fitted between the clamps and well fastened. After the clamps are all fastened the ropes may be removed and the tops of the remaining frames cut off. A few braces should, however, be fastened across the boat to prevent any change of form, as there may be a tendency to spread amidships, and it must not be allowed.

In each bilge a stringer is to be fitted. It is of hard pine, 1 in. thick and 4 in. wide amidships, tapering to 3 in. at the ends. These stringers are bent around in such a manner as to lie flat on the frames and are held in place by shores to the beam above. They are held by fastening to the frames with nails or screws, and should be fastened at each edge to every frame.

Before going farther, the hole for the rudder post tube would best be bored, as it is more accessible now than after the deck is fitted. This tube is a piece of 1 in. standard iron pipe, galvanized and threaded for a length of about 8 inches. The hole is bored of the size of the bottom of the thread, and care must be used that it is exactly plumb and fair with the stern-post. No harm will be done if the hole passes through the stern knee, as shown. If the hole, as first bored, does not come exactly fair and in line with the stern-post, it may be trimmed out somewhat with a gouge. In any case, when the rudder post is in place it must be in line with the stern-post when viewed from aft. The tube may now be smeared with white lead and screwed down into place with a pipe wrench. It should be turned down until it projects below the fantail an inch or more.

The deck beams are preferably of oak and sawed to shape out of a 1½ in plank—they are 2 deep and are cut to such a curvature that the longest beams have a camber of about 3 in. in their length. They should, of course, be planed all over, and their upper edges especially should be an even, fair curve, so that the deck plank will lie evenly. The beams are fitted on the top of the clamps and just aft of the frames, and are fastened to both clamps and frames with screws or rivets. Care must be taken to see that the upper faces of the frames are in the same line so that the deck plank will lie fair and even.

In order that the coamings of cabin and standing-room may fit neatly, curved pieces are worked into the corners between the clamps and the beams, as shown in the deck plan; they are of oak and are fastened to both clamps and beams. The next step will be to lay the deck. A covering board of oak is first to be bent around the outer edge of the deck to add strength

and form a finish. It is ¾ in. thick, 3 in. wide amidships, and 2½ in. wide at the ends. The projecting top of the stern is trimmed up square, and the end of the covering board neatly fitted to it. The clamp, beams and upper edge of the top streak are to be joined and smoothed down to an even surface so that the covering board will lie evenly.

In bending the covering board into place it may, perhaps, be well to steam the forward end where the curvature is greatest. When bent around it should be held in place with clamps until fastened. Just aft of the stem head a short beam should be fitted on top of the beam already fitted, as otherwise there will be nothing to support the ends of the deck plank. The covering board is held in place by nails driven into the edge of the top streak, the beams and the main clamps. Especial care must be taken with the joint between the covering board and the top streak, as this joint is very plainly in view and must be tight.

At the after end the covering boards are cut with a mitre joint, and a piece of similar size is fitted across the stern, joining both covering boards. To support this cross piece, short pieces are nailed to the inside of the stern board. A board about 4 in. wide is also fastened to the under side of the boat and projecting 1 in. beyond the edge of the after covering board; this latter is to support the ends of the deck plank.

The deck plank should be preferably of white pine, as this wood makes a very fine deck, but almost any other kind may be used if the above is not obtainable Whatever stock is used should be clean and straight grained, and if possible the two lengths which are laid alongside the cabin and standing room should be in a single length. The stock should be ¾ in. thick and in about 2 in. widths, so as to bend easily. In laying, the several planks are bent around inside the covering board, one after the other. An oak board 5 in. wide should be fitted lengthwise in the middle of the forward deck, running from the forward end of the cabin trunk to the stem and being fitted nicely to the stem and covering boards. It is fastened to the deck beams with counterbored fastenings. A similar board 4½ in. wide is fastened in the middle of the after deck and neatly fitted to the after covering board. As will be seen, there are only two plank, one on each side, which run the whole length, the remainder being short. The forward end of these plank are fitted to bear against the middle plank, and are bent around inside of the covering board and the after end fitted to the after covering board ; they are fastened to beams and clamps with counterbored fastenings. The upper corners of each plank should be slightly beveled before being laid, so that the seam will be slightly open to admit the insertion of the calking. The single deck plank should be found to have its inner edge just even with the inner edge of the main clamp. If for any reason this does not occur, another plank may be laid the whole length and trimmed out to come even with the clamp. The remaining planks are all short lengths and are fitted very quickly ; the ends are all fitted against the middle plank.

It may be found necessary to fasten some short pieces to the under side of the middle plank between the beams, and projecting over beyond the line of the cabin and standing room and the ends trimmed off later to the correct curve. All fastenings in the deck must, of course, be counterbored forand the holes filled with bungs, in the same manner as before described. If necessary, the deck should be smoothed somewhat at this time, leaving the final smoothing, however, until the last. The deck must also be calked with cotton and the seams either filled with putty or marine glue ; the latter is preferred as it is elastic and perfectly water proof. It is poured into the seams in a melted condition, but full directions can be obtained where the glue is purchased so will not be given here. If one is less particular as to the appearance and finish of the boat, the covering boards, instead of being carried to the stem may be allowed to run off straight after being bent to the curvature of the house sides, and the whole of the decks between them filled with a few wide boards ; this is strong enough, but is not really to be recommended, as the time saved is not worth the difference in appearance. The ends of the deck plank are now to be trimmed out to the curve of the trunk and standing room ends.

The cabin trunk is next to be bent into place. For this purpose a ¾ in. oak plank 15 in. wide and about 17 feet long will be required. Before bending it to shape the outline of the lower edge must be gotten ; to do this a thin board 8 or 10 in. wide is used, being bent around in the position which the covering will occupy. A line is scribed on the board even with the deck, the board is then removed and trimmed down to this line, and when laid on the oak plank will give the outline of the lower edge of the coaming. The latter is then cut to fit the pattern. The coaming will require very thorough steaming in order to render it sufficiently limber ; the stock also should not be too dry, as in this case it is likely to break during bending. It is better to use a rather green piece of stock and allow it to season in place. The plank is well steamed and carefully bent around into place, using clamps to draw it into the sharp bends. It must be held firmly by plenty of clamps, and fastened in place by heavy screws before it is thoroughly cold. A brace should be fastened across the after end to prevent the sides from springing out. When properly fitted it should slope slightly inwards all around. It must be allowed to thoroughly dry before being disturbed further.

The coaming should now be cut off about 1 ft. back from the position of the bulkhead. The top of the coaming also, is trimmed down to the correct outline and should stand about 2 in. above the deck at the center forward.

The standing-room coaming will probably need to be in three pieces with the joints about on number 6 mould. The oak plank for this coaming will need to be 9 or 10 in. wide and ⅞ in. thick. The after curved piece is first bent into shape, as described, for the

r unk. The projecting ends of the trunk coaming are trimmed on the inside down to the thickness of the coaming ; this allows the standing-room coaming to be joined to it and make an even thickness. The two side pieces of the coaming are next to be fitted ; they are butted against the after piece and joined by a butt block about 10 in. long on the outside, fastened with screws. They are joined to the trunk coaming by halving each and fastening with rivets. After it is all fitted it is to be trimmed down to a height of 3 in. above deck, and at the forward end the curve is worked as shown at the after end of the trunk. The top edge of the coaming is rounded off neatly all around.

The beams of the cabin trunk are of oak ⅞ in. thick by 1½ in. wide, and are cut to a crown of about 5 in. in the length of 5 ft. They should be smoothly planed and the lower edges beaded. Starting with the inside of the after bulkhead, the beams are spaced 9 in. apart, center to center ; they are dovetailed into the trunk, care being taken that the dovetail does not cut through to the outside of the trunk. The beams are then inserted from above and the top edge of the trunk beveled to the proper angle of the beams. The top of the house is of ⅞ in. tongued and grooved pine and is laid with the beaded side below. It is laid fore and aft, starting at the middle and working towards the edges nailing to the frames and trunk sides. It is trimmed off around the outer edge of the coaming but across the after edge it is left long and trimmed off later.

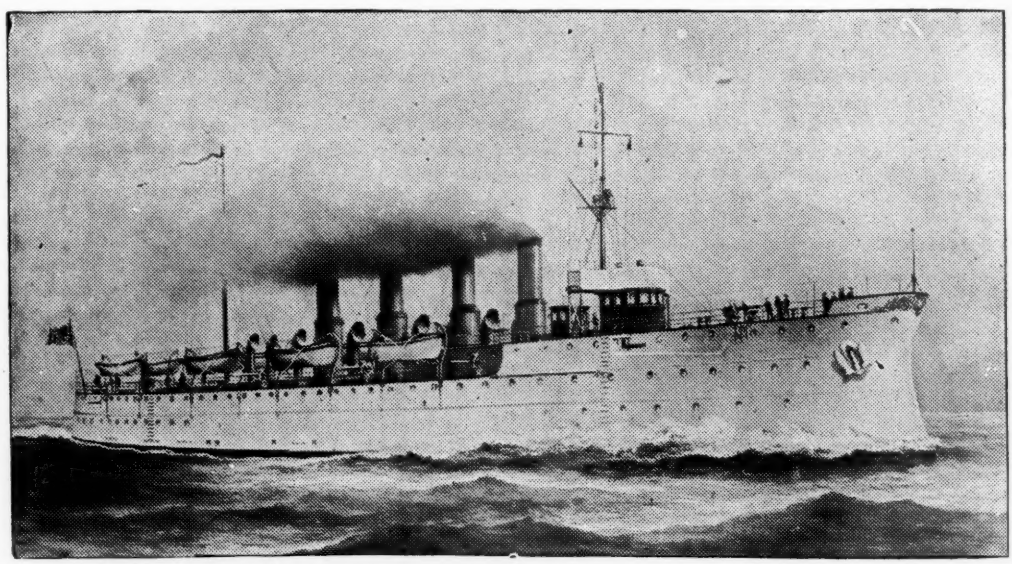
The after bulkhead is next to be fitted on the after side of the last roof beam. This bulkhead is of ⅞ in. stock, matched. It has been figured that the lower edge of this bulkhead would come so that it can be nailed directly to frame, but if this can not be done cleats can be fastened to the inside of the plank. The bulkhead runs to the side of the boat and should be made as strong as possible, as it is a valuable brace to the boat. A door 2 feet or so in width is left in the center. The after edge of the house top may now be trimmed off even with the face of the bulkhead.

TRIAL TRIP OF A BATTLE-SHIP.

ALBERT GRAHAM.

To a few only is given the pleasure of witnessing a full power, speed and endurance trial of a large ship, such as our battleships and cruisers. I will try to describe to the readers of this magazine a trial trip of a sea-going war ship, and endeavor to show, in a very meagre way some of the life and action that is going on in the dark depths below decks.

On the night before the trial, and, in fact, for several days before, the massive machinery has been thoroughly inspected and made ready for the run. All depends upon the high efficiency of the power plant, and great care is exercised to see that there is no possible chance for an accident. Very early in the morning, long before the sun has even tinted the eastern hori-



U. S. SCOUT CRUISERS CHESTER, BIRMINGHAM AND SALEM.

zon with the first signs of dawn, begins the vibration of auxiliary machinery throughout the ship, and a dull hum arises from the depths of the hold as the men are getting everything in readiness.

Dressed in an old suit of clothes and making a hasty toilet, we make our way along a narrow passageway to the brass-railed ladders leading to the engine rooms below. As we pass through the hatch in the protective deck, a gust of hot steam-and-oil laden atmosphere envelopes us, and far below in a misty light, forms are hurrying to and fro attending to duties too numerous to mention.

But down we go through a forest of pipes of all sizes, some hot, some cold, some as large as our body and others not larger than our middle finger, all apparently hopelessly jumbled into an inextricable mass with numberless hand wheels peeping out here and there. As we pass the middle landing our gaze falls for the first time upon the massive reciprocating parts of the main engines, all brightly polished and standing out boldly against the more puny columns, handling gear and pipes.

Upon reaching the lower landing, or engine room floor, a man rushes past with two buckets of oil, while all around us are busily engaged men, each performing some particular duty previously assigned. Passing forward through the power-closing, water-tight doors into the passage that leads to the fire-rooms, then through the air-lock doors, we are ushered into the first fire room.

Here all is life, bustle and activity. Great yawning incandescent mouths are devouring shovelful after shovelful of coal as the firemen toss it to the further end of the furnace with apparently little effort. And you ask, "Why, is that little pile of coal all that they carry?" as you see perhaps a couple of tons piled along the middle of the floor, from which each fireman takes, but no sooner has the sentence left your lips than there issues from a small door in the side of the room, which is really the coal bunker bulkhead, a black, grimy form bearing, or helping bring through a large bucket of coal, which is dumped alongside of the other. And thus it goes, with the exception that while on the run all the coal used is brought out in bags and each bag is supposed to contain an exact amount. One of the official observers counts these bags and thus determines the exact amount of coal burned during the run.

As we look up at the massive boilers we see a man whose duty it is to simply tend the water and see that it never falls below a certain point in the gauge glasses. Upon looking through a door in the center-line bulkhead we see another fire room just like the one we are in; and, walking forward, we pass through two more.

We now go above and take a walk on deck where everything is quiet. Overhead floats a cloud of dense black smoke from the funnels forward. The sea is smooth and the stars are dimly twinkling a farewell as they retire before the rising orb, now just climbing over the edge of the sea, turning the intervening stretch into a lane of fire and liquid gold. We have not long to wait before we see in the distance a tug approaching, brim full of saucy importance and bearing the official observers, reporters, photographers and guests. As she nears the side we, for the first time, realize how massive our leviathan really is, as our rail towers way above the tall stack of the tug. One by one her passengers climb up the ladder on the side and gradually disappear below, while the tug backs away to await the visitors' return.

By this time everything has been made ready and we return to the engine rooms. On the bulkhead behind us are fastened gauges, clocks and various indicators, while below stands a large dial and gong, a mechanical telegraph connecting with the bridge from where the movements of the ship are directed. We are suddenly startled by the clang of the huge gong, and the pointer moves around to "Ahead, slow." The engineer opens the throttle slightly and the huge arms begin to move up and down as the shaft revolves. There is hardly a sound, so perfectly does the engine run, and as the gong clangs again with the indicator pointing to "Ahead, Half," we realize that our ship has headed for the course.

Everthing seems to run like clockwork. All the auxiliary machinery is running steadily, and the large engines are turning over about sixty revolutions per minute. Our steam gauge has long since reached the 230 pound mark and our engineer signals that everything is in readiness.

Again the gong clangs out "'Full speed ahead" and a few turns of the throttle gives our engines 130 revolutions per minute. This speed, for a large engine, cannot be realized unless seen, for it means tons of rapidly revolving metal.

Before long the atmosphere begins to be filled with vapor and flying oil. The huge cranks are splashing it everywhere, while oilers with large syringes squirt pints of oil on the piston rods and guides. But oil does not count. The main question is to "keep her going cool." The floor soon "swims in oil" and lumps of white grease are spattered over everything within reach. As we pass into the shaft alley, the thrust collars and shoes are a mass of foam, and perhaps here and there a stream of water may be playing on a bearing to keep it cool. The damage a hot bearing may cause is, indeed, great, and no end of pains is spared to prevent it. You remark upon the coolness of the room. Yes, it is cool for an engine room. The temperature seldom goes above 85° or 90° in the winter, but somewhat higher in the summer and in southern climes.

Again we go into the fire rooms, but this time we are almost swept from our feet by the blast as the air-lock doors are opened. The fire-rooms are now closed and are under forced draft. Large fans are driving the air into the rooms under pressure, so that the fires may burn hotly and generate sufficient steam. You can see what force it has as the finer particles of coal are carried from the shovel into the furnace before

reaching the open door.

You also notice how each furnace is fired in regular order. No adjoining furnaces are fired consecutively, but perhaps in this order: If there are eight furnaces in the fire room, 1 and 8, 3 and 6, 4 and 5, 2 and 7. This prevents too much unburnt coal being put into one furnace, which would chill it, and, besides, there is less cold air let into the furnace at one place. But upon our return to the eugine-room, behold our finely polished engines completely covered with a coating of white grease; the floors are slimy and slippery with oil; the men are soaked from head to foot with oil.

But as we are nearing the end of the course we go up on deck in time to see the last stake boat loom into sight, and we feverishly await the passing, for we are told that probably we shall make more than twenty-four knots per hour if we can pass her in twenty-three minutes. From the bows we are sending spray in every direction, and a churning mass of foam glides past us as we lean over the rail. Walking to the stern we see a turbulent churning wake stretching as far as eye can see.

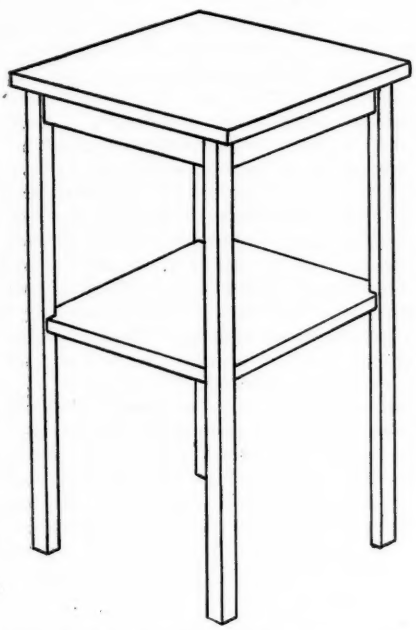
Directly beneath us we see the silver-white blades cleaving the pale green water, and can almost trace the very thread that is being cut in the waves.

We are now passing the stake boat, and soon begin to make the turn for the return run. Our first run has been against the tide and our return will be, for the greater part, with it. But not for a moment has the throbbing pulse below ceased, and neither will it until the finish, for she must prove herself capable under the severest strain.

AN OCCASIONAL TABLE.

JOHN F. ADAMS.

Small tables are always in demand for various uses, and the one here described will be found very serviceable in hall, library or chamber. The wood used for constructing it should be finished to correspond with the other furniture in the room where it is to be placed.



The top is 15 in. square and $\frac{7}{8}$ in. thick, of one piece, if possible. It should be of well seasoned stock to avoid subsequent warping, and planed smooth and level. The legs are $1\frac{1}{2}$ in. square, and 29 in. long. Mortises $\frac{5}{8}$ in. wide, $\frac{3}{4}$ in. deep and 2 in. long are cut at the top ends to receiye tenons on cross-pieces under the top, which are $11\frac{1}{2}$ in. long, 2 in. wide and $\frac{5}{8}$ in. thick, allowing $\frac{3}{4}$ in. on each end for tenons. The fitting of these cross-pieces should be very accurately done, otherwise the table will not be firm. The joints are glued and pinned with 3-16 in. dowels. In boring the holes for the dowels be careful not to split the wood.

The top is attached to the cross-pieces by screws put through from the under side. First bore $\frac{1}{4}$ in. holes, two in each cross-piece, to a depth of about $1\frac{1}{4}$ in., then following with a gimlet bit, a trifle larger than the screw. By placing the top of the table on the floor, with the under side up, and then placing the frame on top, first having marked lines to show the proper position, the holes in the top can be bored and the screws then put in so they will hold very securely.

The under shelf is $12\frac{1}{2}$ in. square and $\frac{3}{4}$ in. thick, 1 in. square being cut out of each corner to fit around the legs. It is well to wait until the frame is made, however, before cutting out the corners, so that any little inaccuracies of fitting may be allowed for. The The under shelf is attached to the legs by screws cornered in from the under side, countersinking for the heads and using a long screw of not very large gauge.

Multiply the number of volts of a storage battery by the amperes, and you will have the number of watts. Divide the watts by 746 and you have the horsepower. From 20 to 40 per cent of the energy developed by the battery will be lost in converting it into power in a motor, the remainder being available for use in the form of power.

WEATHER INDICATIONS

AFFORDED BY ANIMALS, BIRDS AND PLANTS.

Observations of the habits and conditions of animals and birds, and the appearance of plants, have a recognized value in determining the character of past weather and, to a limited extent, the weather for a few hours in the future. In a state of nature the condition of animals and plants is an indication of the character of past weather, so far as it has affected their physical condition in the one case and their growth and preservation in the other. The appreciation of animals and plants for future weather must necessarily be limited to the effect or influence upon their organizations of present atmospheric conditions, and in the case of animals the sensations that are produced by certain conditions or variations of atmospheric moisture, pressure, temperature, etc., are instinctively associated with the kind of weather that usually follows the kind of sensations experienced. Neither animals nor plants can possibly be affected by the weather of a future month or season.

Undomesticated or wild animals, fowl, and birds are usually used as an observation basis for long-range forecasts. Animals, such as the ground hog, or woodchuck and the bear, that make winter a season of hibernation, are supposed, by the character of their preparations and the time of their retirement, to indicate the length and strength of the cold of the approaching winter, and towards winter's close they again become prominent factors in this scheme of forecasting. For, according to weather folklore:

If, on Candlemas day the weather is bright and clear, the ground hog will stay in or return to his den, thus indicating that more snow and cold are to come (and there he stays for a period that varies in length in the different sayings that relate to this act from two to six weeks) but if it snows or rains he will creep out, as the winter is ended. The bear comes out on the 2d of February, Candlemas day, and if he sees his shadow he returns for six weeks.

If the saying regarding the coming out of the ground hog and the bear on Candlemas day possess any merit it rests upon the fact that fine and clear days in the early part of February are usually cold days, and that cloudy weather at that season is likely to prevail during warm days. The animals in question, therefore, consult their own comfort in cases where they make a premature exit from winter quarters. If it is cold they return; if it is not cold they remain out until the inevitable return of cold weather, which at that season will not be delayed many days.

The thickness of the fur of fur-bearing animals is also used as evidence of the character of approaching winter, when, as a matter of fact, this depends absolutely upon "the physical condition of the animal, and his physical condition depends upon the weather of the past and the extent to which it has affected his food supply and general health, rather than upon the weather of the future."

The accumulation of food by squirrels, beavers, and other animals during the autumn months is also taken as a guide to the character of the coming winter. It is assumed that the gathering of a large supply of food indicates a long, hard winter. Careful observations of the habits of animals show that the autumn habits referred to or their omission bear no relation to the character of the following winter. The quantity of nuts stored by squirrels is governed by the supply of nuts at their disposal. In seasons when the crop is abundant the busy little animals will gather a large quantity, and when nuts are scarce his accumulation will be correspondingly small. The supply of nuts is governed by past and not future weather.

Birds of passage migrate to the south with the first breath of winter, or when their food supply is affected by inclement weather that is peculiar to approaching cold weather, and return north when spring sets in in the south. That their flights are influenced by present rather than a knowledge of future weather conditions is evident to all observers. Their judgment is on a par with that exhibited by some men in doffing or donning winter clothing; their actions are dictated by a sense of personal comfort, and they are often compelled by actions to admit their error.

The thickness of plumage on wild and domestic fowls is also a result of feeding and past conditions of weather, rather than an indication of the character of future weather. And the goose-bone theory is one on which no two geese agree.

Moss, bark on trees, and the thickness of nut shells, pumpkin rinds, etc., furnish another basis for long-range weather speculations that also confuse and misinterpret conditions that are due to past conditions and have no bearing on future weather. There is one feature of tree weather forecasting, however, that possesses merit in so far as it presents as a basis a record of the general character of the weather for many years, and may thus show or indicate recurring seasons of certain kinds of weather. Trees of great age and large growth, like the sequoias, indicate by their rings years that have been favorable and unfavorable for their growth, or, in other words, wet and dry years in the region in which they are located, and thus establish a record of the seasons that may be useful in calculations for the future.

In passing, it will be noted that prominent advocates of this branch of long-range weather forecasting have long since disappeared from public view, which fact may be taken as indicating that dishonest practices can be profitably conducted only by the possession, or an assumed possession, of superior knowledge, or under a cloak of mysticism, and not in connection with matters concerning which ordinary observation will reveal the truth.

Many useful tools can be obtained by securing new subscriptions for AMATEUR WORK.

THE SCHOOL OF THE APPRENTICE.

FREDERICK A. DRAPER.

Not every young man has the fortune (or, shall I say, misfortune) to be born with a silver spoon, and has the means wherewith to obtain his education at a technical college. And to those upon whom Fortune has not thus smiled, and yet who desire to advance in the paths of learning, the picture of the student, surrounded by willing instructors and expensive equipment, is an alluring one, well calculated to make the unthinking have envious thoughts and bemoan the fate that forced him to hours of labor rather than study. It is but natural that one wishes for what he has not, and fails to realize the value of that which he has.

And so with the young man who begins his apprenticeship as a mechanic ; he thinks of the greater progress he might make if he could but graduate at a technical school, forgetting that at hand and without cost, he has what no student can get, the instruction of that greater school of "experience" as developed by the stern necessities of industrial progress.

It is well, therefore, for the one whom ambition urges forward, and who, unaided by fortune, must make the fight solely by his own exertions, to consider the nature and extent of the handicap under which he labors, and to determine the ways by which he can overcome the obstacles in his path and eventually reach the place in the affairs of life which he pictures in such glowing colors at the start.

And is the position of the student so greatly superior to that of apprentice? Four years of theory, with hardly enough practice to assimilate more than a small part of the instruction. The real start is made when, leaving college doors behind, the student becomes a worker in competition with other workers ; the stored knowledge must then be drawn upon and used intelligently to keep up in the race. Now, natural ability begins to tell, and when seconded by strong determination and persistent striving for advancement, the years of study return many fold their cost in time and money.

If the student has to travel such a rugged path, how much more difficult is it for the apprentice to succeed. Not so. The latter has many advantages which offset in considerable measure the loss in an educational way. He sees around him operations conducted on a large scale, with varied and perfected machinery designed to produce work of the utmost accuracy at a minimum cost. Results are what count in the shop, and new and better machines replace those that cannot meet requirements of output or quality. The apprentice learns processes, therefore, from simple observation.

He requires no time for instruction in what is fully demonstrated before him. The great lessons of economy (of time) and accuracy are learned without effort, become a second nature to him, and his reasoning, as he advances in skill, conforms to the necessities of these two fundamental laws of production. It is here, also, that the apprentice meets and masters (or fails) that which the student possesses in abundance, theory. It is quite as necessary for the apprentice to study the theory of his work, the laws of mechanics, as it is for the student to acquire practice, and neither will reach any advancement worth mentioning until this has been done.

The supplementing a day of manual labor with an evening of mental work, will not seem attractive to the young man of social disposition. The theatre, social gatherings and numerous ways present alluring inducements to leave dry text-books behind. And text-books are dry if the mind is elsewhere, but not if an earnest disposition to know them is accompanied by regular hours of study.

As soon as the routine has become fixed, the work will take on a new interest, and in a surprisingly short time the regret will be that more time is not available for reading and study. In addition, the shop work will be found of increased interest, new work will be taken up with intelligence, and soon recognition will be given by superintendent or foreman. The practical value of theory will then be self evident, and the shop-educated workman will be found shoulder to shoulder with the college graduate because both are equally competent, although educated in different ways.

"But how can the apprentice study theory, with no one to direct his study, correct his errors and give needed instruction ?" This is a problem which each one must work out for himself. It must be a very small town in which there is not some one to be found by diligent inquiry, who would quite gladly assist in settling the larger problems ; the smaller ones can nearly always be solved from books to be found in the public library, or purchased for a moderate sum. The accumulation of a select list of technical reference books and treatises will follow as a matter of course.

For self instruction the correspondence school is the nearest to resident instruction which it is possible to obtain, and the courses offered by the larger and better ones are very complete and extensive enough to carry one far on the road to a good technical education. They have an added value, inasmuch as the beginner is more inclined to persist in his studies until regular habits have been formed and possible reluctance been replaced by eagerness and quickened ambition. A good start is everything, and for that reason advantage should be taken of every help which will tend to make first work easier and more inteligible. As the text-books and instruction papers of correspondence schools

are written especially for use in home study, they possess advantages over many general treatises, and also have test questions and frequent examinations to determine the thoroughness with which the work is being followed. To one who seeks instruction for its own sake, these correspondence courses are invaluable.

In conclusion, the comparative advantages of the two ways of acquiring a technical education may be summed up as follows:

The student in the technical college acquires an immense stock of theoretical and some practical knowledge, which makes the acquiring of more knowledge easy and rapid.

The apprentice in the shop learns the practical side and sees about him the application of the theoretical principles underlying mechanical operations, which he recognizes when such principles have been learned. To succeed, therefore, the apprentice must learn theory, and when this is done, the application to practical operations will be easy.

The value of such effort on the part of the apprentice should be self evident. The demand for the skilled workman was never greater than it is today. The apprentice is soon the workman, the foreman, the superintendent, the engineer. The reward is assuredly great and easily within the reach of him who will persistently and industriously seek it.

FINISH FOR NATURAL WOODS.

Suggestions regarding the finish for natural woods in interior work are always interesting, and our readers are likely to obtain a hint or two regarding this matter from the reply presented in a recent issue of the *Painter's Magazine* to a correspondent of that journal, who stated that he desired to give a dull finish to the wood work of three rooms, one of which was to be in birch, another in oak and the third in Georgia pine. He wanted to know the best method of producing the desired result, stating that he had had poor success in filling oak, and raised the question if he should apply two coats of paste filler. In conclusion he inquired what was best for rubbing, pumice stone and water or pumice stone and oil?

In reply to these questions the journal named offered the following: Birch belongs to the close grained woods and does not necessarily require filling, yet where it has been stained, many finishers are of the opinion that paste filler colored to suit the stain brings out some pretty effects not otherwise obtained. Whether filled or not, at least one coat of white shellac should be applied before the rubbing varnish is put on, and the latter need not be extra pale for this wood. Two coats of interior or cabinet rubbing varnish at least are required for a good finish, and three coats are none too many. Each coat of varnish should be permitted to stand 48 hours, and then be lightly rubbed with steel wool or curled hair before applying the next coat. The final coat should be allowed to stand a least three days, and then be rubbed to a dull finish with pumice stone and water. The work must be cleaned up well, and if the finish is too dull, go over it with a little rotten stone and rubbing oil. The pumice stone must be free from grit in order to avoid scratches.

White oak, as well as dark oak, belongs to the coarse, open grained variety of woods, and is difficult to fill properly. However, we do not believe in two applications of paste filler, and if one application is insufficient the fault is with the quality of the filler, though it may be in a measure due to inferiority of the wood.

Color the paste filler, if necessary, to suit the wood, apply one full coat, allow to set from 15 to 30 minutes, remove the surplus with waste or excelsior shavings, and after 24 hours sandpaper lightly and dust off. Then apply a thin coat of white shellac varnish, and when dry, again sandpaper lightly and you will find the wood well filled. Now apply the interior rubbing varnish, treating each coat as described for birch. Georgia pine is a sappy, close grained wood and requires no paste filler, but it is best to give a thin coat of white shellac varnish, which, when dry should be sandpapered lightly. Over this coat of shellac as many coats of interior rubbing varnish as your contract will permit should be applied, each coat to be rubbed as above. A light colored varnish is recommended, because varnish of dark color does not make a good appearance over this wood.

An ingenious suggestion was made recently by Major G. O. Squier, of the signal corps of the United States army, which, if it proves practicable, will be of great service to the signal corps. Major Squier says that as a living organism may form a part of an electrical circuit, it is possible to utilize a tree as the aerial of a wireless telegraph system. Connections should be made near the ground and where the branches begin to spread, by the simple method of driving in two iron nails to which the receiving device is attached. If the plan works well in practice there will always be suitable aerials for army use, except in a very barren country. Probably a tree is not as efficient as a metallic wire properly suspended, but as the distances to be covered in army signalling will never be great, this is a small matter. A more important point is the deduction that if a tree can be used in this way with good results, it would seem to follow that an intervening forest adds to the difficulty of transmitting messages over land. It may, in some cases, make the operation of a wireless system, under such conditions, practically impossible.—*Elec. Review.*

The city of Paris now has street sweepers, fire engines, post-office vans, and dust carts propelled by motors.

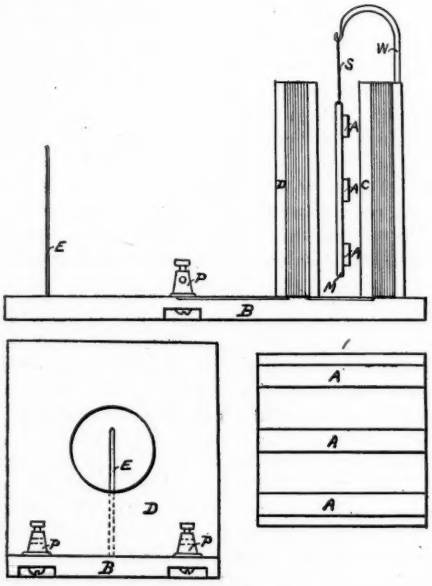
JUNIOR DEPARTMENT.

A SIMPLE GALVANOMETER.

PHILIP C. HOLDEN.

Any of the younger readers of this magazine who may desire to construct a galvanometer, will find the one here described quite easy to make and sensitive in action with the small currents to which its use is restricted.

The baseboard, *B*, should be made of oak or maple and is 5 x 2½ x ¼ in. Two other pieces, *C* and *D*, upon which to wind the coils, are 2½ x 2½ x ½ in. Around the edges of these two pieces cut flat grooves, ¼ in. wide and ⅛ in. deep. In the center of the piece *D* bore a hole 1 in. in diameter. The grooves are then filled with cotton covered magnet wire, No. 18 gauge, wound in even layers, the coils being each wound in the same direction and the ends joined as though both were but one coil. They are then fastened to the base board with brass nails, boring holes with an awl, or they may be glued, holding them down with clamps until the glue is quite hard.



Two binding posts are mounted on the base board to which the remaining ends of the coil are fastened. At the top and at the back of coil *C* a piece of brass wire is inserted in a hole, previously bored, the free end being bent to a curve, as shown in the illustration, an eye having first been formed by filing the end of the wire flat and then bending.

A piece of mirror, *M*, made on thin glass 2 in. square, is then suspended by a silk fibre, *S*, drawn from a piece of discarded bass string of a violin. The silk is attached to the center of the top edge of mirror with sealing wax. Before doing this attach to the back of the mirror three pieces of thin spring steel, *A*, 2 in. long, ¼ in. wide, spaced ½ in apart. To do this coat one side with shellac, place against the mirror and hold in position until the shellac sets, which takes but a few moments. These pieces of steel should be previously magnetized, care being taken to mark the N pole on each and to have the same poles on the same side of the mirror.

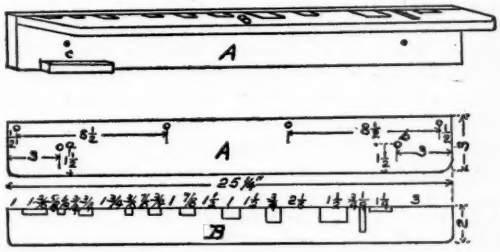
One half inch from the other end of base board, bore a small hole and place therein a polished steel wire 1¾ in. long, above the surface, (a piece of a knitting needle will serve.)

In using the instrument place in such a position as regards the polarity of the earth that the mirror will be exactly parallel with the coils. This can be ascertained by sighting from the needle through the hole in *D* and observing when the reflection of the needle is exactly connecting the current to be tested, the mirror will turn because of the influence of the coils on the magnets.

SMALL TOOL RACK.

GEO. E. GREGORY.

How many times may one enter an amateur's workshop and see the various tools scattered about on the benches. And what a contrast with the shop where the tools were well arranged in racks. To help readers of this magazine to be in the latter class, the very handy tool shown in the illustration, is here described. Most any kind of wood will do, but ash, whitewood or gum wood are suggested as being the best. If looks are to be taken into consideration the latter is probably most suitable. Two pieces of wood are required, one of which, *A*, must be 25½ in.



long, 3 in. wide and ⅝ in. thick, and the other, *B*, 25¾ in. long, 2 in. wide and ¾ in. thick.

After sawing and planing this piece to the size given and rounding off the corners as shown in the figure, holes are drilled and countersunk in the positions indicated. The two holes *a* and *b*, should be countersunk on the front of the board, as they are to be used in holding the rack in place against the wall. The other four holes shown are countersunk on the back side of the board. Screws are to be passed through these holes to hold the smaller board, *B*, in position, using 1¼ in. No. 10 screws in all places. The board, *B*, is sawed and planed to size given, and a series of notches for holding the tools are cut on the rear edge.

This particular arrangement of notches is good, but the maker can adopt such an arrangement as would be best suited to the tools he will place therein. In this rack the tool arrangement provided, beginning at the left side, for rule, pencil, knife, ¼ in. flat chisel, ⅝ in. flat chisel, ¾ in. flat chisel, spoke shave, scratch gauge, hammer, and next the claw, and lastly the blade of the try square. These notches are made by sawing inside lines previously made, in laying out, and then the remainder of the stock taken out with a chisel.

In order that the pencil and ruler shall stay in place a small piece of wood, *C*, 2½ in. long, ½ in. wide and ⅝ in. thick, should be screwed onto the back board with ½ in. screws in a position directly under the slots for pencil and rule.

To finish, the parts of the rack should be given a coat of shellac and then allowed to dry for an hour before giving it the second coat. The parts are then assembled, and the amateur has a piece of furniture which will prove well worth the short time required to make it.

SCIENCE AND INDUSTRY.

One of the avorite methods of forming accumulator plates quickly is that due to Lucas, in which sodium perchlorate plays an important part. In general it may be assumed that the best substances for assisting in quick formation are those bodies which either do not change during electrolysis or the changes of which are easily controlled. Hence one may expect that inorganic bodies will be more favorable for producing quick formation than organic bodies. Another important feature of the substance used for quick formation is its purity. Bearing these facts in mind, it seemed to Dr. Schmidt Altwegg that potassium chlorate might be very effective in hastening the formation of lead plates. Experiments were conducted to determine whether this was so. The plates were formed in an electrolyte of 0.03 specific gravity, which consisted of chemically pure sulphuric acid mixed with distilled water, and containing one per cent of potassium chlorate. The current density was 0.613 ampere per cubic decimetre of exposed surface. The charge lasted uninterruptedly for twenty-four hours, after which the plates were charged in the opposite direction at the same rate for an equal length of time. The plates were then carefully washed and set up as positive plates in a cell. They were finally charged for sixty hours at the rate of 0.413 ampere per square decimetre of surface. Following this charge they were discharged at the rate of 0.226 ampere per square decimetre of positive plate. It required twenty minutes to discharge them. Upon reformation the voltage upon discharge fell to the same point after fifty minutes, and after a third charging, two hours were required to the point. The voltage at the end of the discharge in each case was 1.83.—*Electrical Review.*

A new system of road locomotives has been brought out by the Siemens-Schuckert Company. It is now in use very successfully on a line running through the valley of the Veischeide as far as Belstein. Current is taken from a double overhead line by a pole and a form of sliding trolley which is adapted to the purpose. The locomotives are equipped with two Siemens-Schuckert motors of twenty-five kilowatts each, and weigh 6.5 tons. They can carry a load of two tons. The locomotive draws a train of three trailers, each of which can carry a net load of 5.5 tons. The present system is controlled by the Schiemann Company, which is specially engaged in operating this form of train. One feature to be noticed is that all cars are connected to the locomotive or with each other by a coupling device somewhat resembling that which is used on the Renard auto train in Paris. Part of the motive power is transmitted through the coupling to the wheels of each car so that it becomes self-propelled to a certain extent. This gives it the advantage of passing around curves in the same path with the locomotive, and it does not obstruct the track. On the other hand, the dead weight of the locomotive can be made smaller.

There are a good many rooms where the radiator is either too small or the steam pressure too low to maintain a comfortable temperature in severe weather. If the tenant is enjoying the many advantages afforded by central station electric lighting service, the matter can easily be remedied. Take the fan that kept you cool all summer and set it where it can blow against a large part of the radiator's surface. Turn it on at low speed or at high, if necessary, and your cold room will soon be thoroughly warmed. The philosophy of the thing is that steam at a low pressure carries much less latent heat than steam at a high pressure, and therefore warms the radiator so poorly that only a slight draft of air rises around the pipes, and condensation is slow. With the fan in operation there is a forced draft against the radiator that conducts a great deal more heat away from the iron, cooling it so much more condensation of steam occurs inside it. The heat thus snatched from the reluctant radiator is held in the circulating atmosphere of the room, which is soon

changed from cold to warm at a trifling cost for electric energy.—*Electricity*.

Great interest has been excited among motorists by the report of the trial on the Seine in France of a new kind of motor boat, which is propelled by a 14 h. p. De Dion-Bouton motor. The peculiarity of this boat is that the principle of the aeroplane is applied to it, and that it practically glides on the surface of the water instead of through it. The boat in question is about 20 feet long and about half that in width. On the bottom are fixed inclined planes or fins, the angles of which increase as they near the stern. When the boat is at rest it floats, more or less immersed, as an ordinary raft would do; but when under power the bow lifts out of the water and the boat glides along on the inclined planes. It is reported that at the trial the speed over a measured course was at the rate of nearly 20 miles an hour, which is about double the pace that could be got out of an ordinary launch with that power of engine. The boat is fitted with two rudders, between which the propeller works.

A beautiful dead black ebony stain, largely used by camera makers for blacking the insides of camera woodwork, carriers, &c., is made by first coating the wood with a strong decoction of ground logwood, or logwood chips, in hot water and then, when nearly dry, applying a solution made by putting 6 oz. or 8 oz. of iron filings into a 20-oz. bottle, shaking occasionally for a few days before using. This will impart a fine and even black to mahogany, or any sort of wood—a black that will neither chip, powder nor rub off, and with a perfect, non-reflective surface. For external parts of apparatus, a more finished appearance will be imparted by rubbing over with boiled linseed oil.

Sir John Primrose, at a recent banquent at Glasgow, made reference to a new process for obtaining a complete combustion of coal. He has experimented in his factories with many previous inventions of this kind in order to abate the smoke nuisance. Recently he tried a new furnace, which seems not only to prevent smoke, but permits a much greater efficiency of the coal used.

The speaker said of the invention that the burning of the coal takes place in a chamber surrounded by a water jacket, separated from the boiler, and that only the gaseous products of combustion are used for heating the boiler.

According to this new process a steamer would require less than one-half of the room now used for the boilers in order to generate the same amount of power, and the weight of the heating apparatus would also be diminished more than one-half. Air and fuel gas are conducted simultaneously to the boiler, and no unburned gases can escape into the air, so that no smoke and no carbonic acid escapes through the smokestacks. For steam purposes it would also be of importance, as it is said that the process permits of the use of inferior fuel.

An experiment for the purpose of testing the durability of liquid air has been made between Berlin and Geneva. The manufacture of liquid air for scientific and technical purposes has assumed considerable proportions in Germany. For the further growth of this industry the question of how far liquid air can be transported without serious loss by evaporation is a vital one. The experiment referred to was made for this purpose.

One morning two quarts of liquid air were delivered to the railroad at Berlin, packed in a manner specially adapted for this purpose, for transportation to Geneva. The shipment arrived in Geneva in five days, and after an additional delay of half a day it was delivered to the chemical laboratory of the University of Geneva. The glass vessel in which the liquid air was sent still contained one-fourth of a quart thereof, which was at once experimented with.

It is stated that this was the longest distance over which this curious liquid has been transported, and the result is encouraging to make larger shipments, where the loss would be relatively less.

Americans will be surprised to learn that it should take five days for such an article to reach Berlin; the same distance in the same distance in the United States would not exceed thirty-six hours.

Under date of November 7, 1904, United States Consul E. Theophilus Liefield, of Freiburg, Germany, reports that a German patent has been taken out for an electrical apparatus whereby the presence and extent of shoals of fish can be ascertained. A microphone, enclosed in a water tight case connected with an electric battery and telephone, is lowered into the water. So long as the telephone hangs free no sound is heard, but on its coming into contact with a shoal of fish, the constant tapping of the fish against the microphone case produces a series of sounds which at once betrays their presence. The rope attached to the microphone is marked so that the exact depth of the shoal is at once ascertained.

It is a good thing to put in the supply line for a gasoline engine near the tank valve which has in it a wire gauze, which will strain the gasoline as it goes toward the engine, preventing any chips, dirt or sediment from reaching the engine and causing trouble, perhaps, by preventing the valves from seating. It is surprising what a quantity of dirt and chips from barrels will some will sometimes get into the gasoline, and many an operator has spent hours trying to find out what was the matter with his engine, eventually to learn that it was from dirt in the gasoline which had prevented the check valves from seating, or some other like trouble.

Education in the true sense is not mere instruction in Latin, English, French or history. It is the unfolding of the whole human nature. It is growing up in all things to our highest possibility.—*J. N. Clarke.*

The New Mexico College of Agriculture has been making exhaustive tests to determine the relative value of crude petroleum, kerosene and gasoline for use in internal combustion engines. Results as given in *Farm and Stock* are that, with a crude oil or kerosene consuming attachment to the ordinary gasoline engine, either was as efficient as gasoline. The tests were made by an engine pumping water for irrigation, but the relative cost of each would be the same in any kind of work. With gasoline, 1,096 gallons of water a minute were pumped, and the fuel cost for 24 hours was $15.95. With kerosene, 1082 gallons a minute were pumped at a 24-hour cost of $25.76. With crude oil, 1,088 gallons a minute were pumped, at a 24-hour cost of $7.07.—*Engineer.*

It has been announced that an effort will be made to keep in communication with Lieut. R. E. Peary in his proposed search for the North Pole by means of wireless telegraphy. Lieut Peary will erect stations at proper points to keep in touch with the coast of Labrador, from which place he hopes to be able to communicate with New York.

A stiff toothbrush and a little gasoline will soon remove soot from spark plugs under ordinary circumstances. If the deposit is hard it may be scraped off with a knife.

TRADE NOTES.

North Brothers Mfg. Company of Philadelphia, Pa., are sending out a neat little pamphlet of a size convenient to carry in the pocket and illustrating and describing Yankee tools. The latter have been named Yankee because they are the invention of a Maine Yankee and because they embody that "ingenuity and slickness in the doing of work for which they are intended which has made Yankee inventions famous the world over." They are simple in construction, strong and durable, do not get out of order, work smoothly and quickly and wear well. The Yankee tools were first offered the trade in 1898, and each year since there has been a notable increase in the sales. The lines include ratchet screw drivers, spiral ratchet screw drivers, chucks, automatic drills, reciprocating drills and pocket magazine screw drivers. In response to frequent demands for the Yankee screw drivers put up in substantial boxes to be used by mechanics who desire to keep the tools in fine order, and by gentlemen or amateur mechanics who especially appreciate tools put up in handsome sets, the manufacturers are offering what is known as the Yankee tool set No. 100. The box contains the styles of Yankee tools most in demand, and the combination in the set covers all the usual requirements in tools for driving in and turning out screws.

In considering the purchase of new equipment during the coming year, the directors of manual training schools in which wood working is taught, should not overlook the band and circular saws, both foot and power, manufacturod by J. M. Marston & Co., 241 Ruggles Street, Boston, Mass. These machines are well designed and well made, and yet sold at very low prices, considering their capacity. For carpenters and cabinet-makers shops they are especially adapted.

The amateur or professional mechanic or worker who visits New York City should not fail to call at the new and spacious store occupied by Hammacher, Schlemmer & Co., Fourth Avenue, corner 13th Street. Here is to be found a large assortment of modern tools displayed so that examination is convenient and selections can therefore be made with the greatest facility.

The attention of readers is called to the advertisement of the Griswold Co., Quincy, Mass., which makes a specialty of supplying castings and parts with which to make up various machines and hand tools. The grinders mentioned in this issue will be found of special value by those making up machine work on which a fine finish or close fit is necessary. The small gas engine is just the thing for power for a small shop, or for a dynamo for house lighting plant. The lathe and hand turning tools are made from the best of stock by workmen of exceptional experienee and may be purchased with entire confidence.

The large and varied line of wood-working machines manufactured by the American Wood Working Machinery Co., New York, will be found to meet the most exacting demands of high grade wood working. These machines are so well known throughout the country that special mention would be almost needless. Their catalogue should be in the possession of every teacher or director of manual training.

The spark coils manufactured by the New England Coil Winding Co., Atlantic, Mass., will be found specially adapted for electrical experimental work and wireless telgraphy for distances within their capacity. There are few electrical instruments which can be adapted to as great a variety of demonstration work as can the Ruhmkorf Coil. For that reason, every one interested in the study of electricity should obtain one at the earliest opportunity.

The new tools recently placed on the market by The L. S. Starret Co., Athol, Mass., and described in the supplement of their catalogue, will be welcomed by the mechanic who endeavors to keep a suitable assortment of tools required by his work. Both catalogue and supplement are sent upon request.

The Manhattan Electric Supply Co., 32 Courtlandt Street, New York, is well known to all electricians as being the headquarters for all kinds of electrical supplies. Special attention is given to orders by mail, and shipments are made with exceptional promptness.